Likelihood selection for spatially resolved tag attrition model

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## Previous Studies

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<td>Adam and Sibert (2002)</td>
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<td>Hampton (2000)</td>
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Tag data

• SPC’s Regional Tuna Tagging Project (1987-1992)

• Yellowfin tuna, skipjack tuna

• Yellowfin tuna: 40,075 released, 4,950 recaptured (12.4% recovery rate)

• Skipjack tuna: 98,401 released, 12,447 recaptured (12.6% recovery rate)
Model description

• ADRM

\[ N_{xyt} = \sum_{c=1}^{C} \tilde{N}_{xytc} \]

the density of tags in cohort \( c \)

\[ \frac{\partial N}{\partial t} = \frac{\partial}{\partial x} \left( D \frac{\partial N}{\partial x} \right) + \frac{\partial}{\partial y} \left( D \frac{\partial N}{\partial y} \right) - \frac{\partial}{\partial x} (uN) - \frac{\partial}{\partial y} (vN) - ZN \]

• 16 Regions
Tag attrition plots

- Yellowfin tuna

- Poisson likelihood
- Negative binomial likelihood
- Lognormal likelihood
Tag attrition plots

- skipjack tuna

Poisson likelihood

Negative binomial likelihood

Lognormal likelihood
POISSON

NEGATIVE BINOMIAL

LOGNORMAL
Natural Mortality

- **Yellowfin tuna**
- **Skipjack tuna**

![Graph showing natural mortality for Yellowfin and Skipjack tuna with Poisson, NB, and Lognormal distributions.](image-url)
Fishing Mortality

• Yellowfin tuna

• Skipjack tuna
**Diffusion-Season1**

- **Yellowfin tuna**

- **Skipjack tuna**
Diffusion-Season1

- Low diffusion appear in R2, R3, R13, R15 in both species.
**Diffusion-Season2**

- **Yellowfin tuna**

![Graph showing data for Yellowfin tuna]

- **Skipjack tuna**

![Graph showing data for Skipjack tuna]
• High diffusion rates appear in the Northern Hemisphere with Yellowfin tuna.
Conclusion

- Tag attrition curve fit is well-fit in order of Poisson > Negative Binomial >> Lognormal
- Lognormal function underestimate fishing mortality and diffusion rate of two seasons.
- Lognormal likelihood function is not a proper selection in ADRM.
- Selection of likelihood function can lead different results in parameter calculation.
**Poisson**

\[ e^{-\lambda} \frac{\lambda^k}{k!} \]

**Negative Binomial**

\[ \frac{\Gamma(r + k)}{k! \Gamma(r)} p^r (1 - p)^k \]

**Lognormal**

\[ \frac{1}{x\sigma\sqrt{2\pi}} \exp \left[ -\frac{(\ln(x) - \mu)^2}{2\sigma^2} \right] \]