How to deal with zero catches?

- **Do not ignore zeros** - these are critical data!
- Use an appropriate distribution that can accommodate zero observations
- Simulate from your model to ensure the model accommodates the proportion of zeros in the data
- We will do this (Hilsha analysis)

How many zeros is too many?

- No specific threshold
- Fit model, then simulate from it
- Does the observed number exceed the predicted (by a lot)

What distribution is appropriate for (many) zeros?

- Gaussian (?), Poisson, negative binomial, Bernoulli, binomial
- Model validation: check by simulating from model and compare proportion of zeros in simulated data sets with observed proportion – they should match
- Use ‘testZeroInflation’ command in ‘DHARMa’ package
- We will do this (Hilsha analysis)

Why do we get lots of zeros?

- Unsuitable conditions – no catch
- Suitable conditions – no catch
- Suitable conditions – not catchable
- Suitable conditions – make error

What type
of zeros
do you
have?

How to handle lots of zeros

- Fit zero-inflated (mixture) models
- Fit zero-adjusted (hurdle) models

ZIP, ZAP!

- Zero-inflated models differ from zero-adjusted models
- Zero-inflated models - model zeros as counts (some of which are zero)
- Zero-adjusted models explicitly model zeros as a Bernoulli model, and counts (zero-truncated data) using Poisson, NB, Gamma

Zero-inflated models

- Model data in two parts:
  - Binomial part; zeros vs. count (use binomial distribution)
  - Zero-truncated data, using Poisson, negative binomial, gamma
- Able to identify which variables result in a catch (binomial part) and if a catch occurs, the size of the catch (zero-truncated part)
- We will use a ZINB model with the Hilsha analysis

Tweedie distribution

- A family of distributions
- Not widely used
- Easy to implement with the ‘glmmTMB’ package
- Able to generate a compound Poisson-Gamma distribution