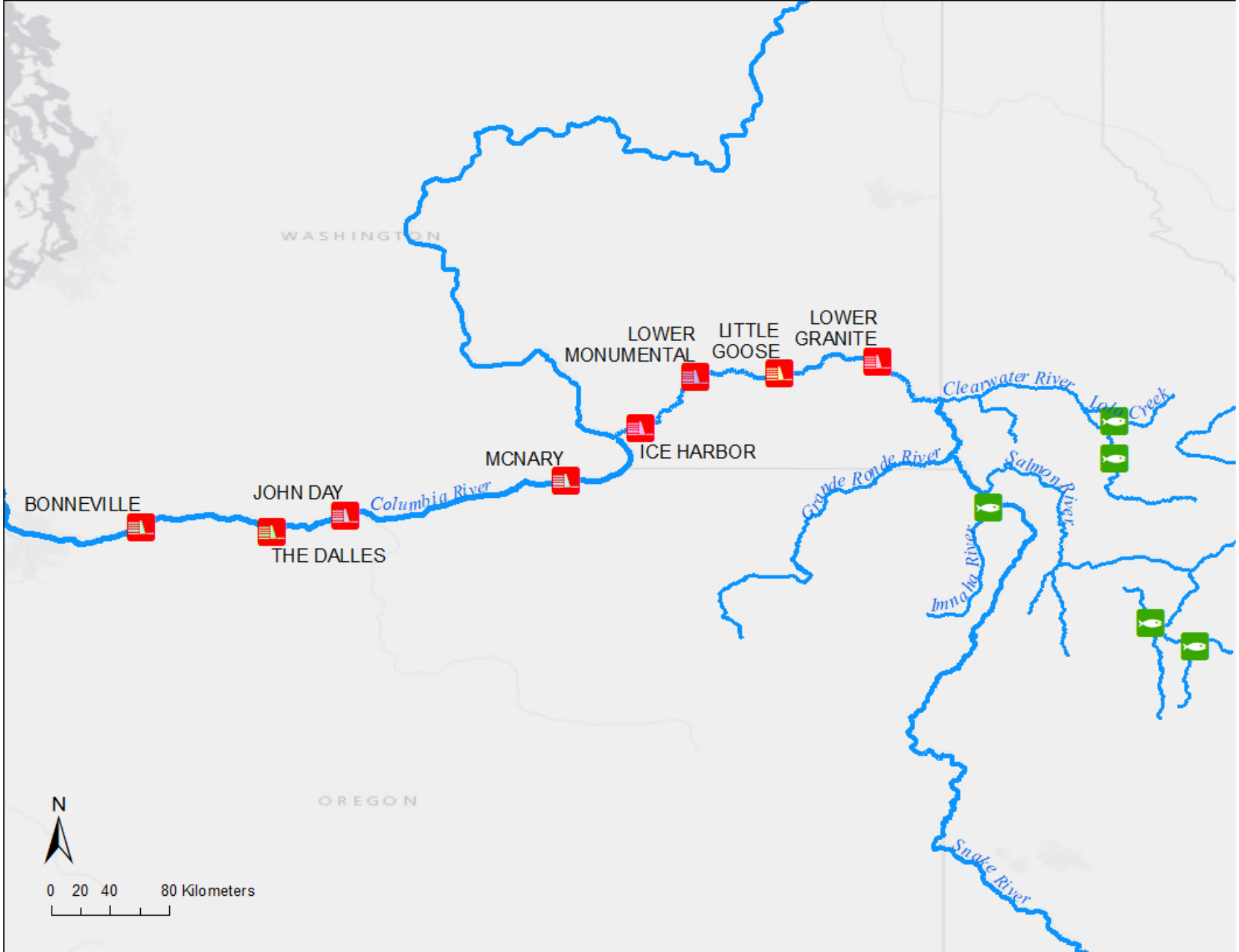
Diversity - the spice of the *O. mykiss* life

Lora Tennant
Nez Perce Tribe - Department of Fisheries Resources Management

Acknowledgements

Crews of past and present
Private landowners
Juvenile Tech Team
Project leaders


WASHINGTON
OREGON
LOWER MONUMENTAL
LITTLE GOOSE
LOWER GRANITE
ICE HARBOR
MCNARY
JOHN DAY
BONNEVILLE
THE DALLES
Columbia River
Clearwater River
Lolo Creek
Grande Ronde River
Salmon River
Imnaha River
Snake River
N
0 20 40 80 Kilometers

Secesh River

est. 2005

Johnson Creek
est. 1998

Redd building and spawning

Eggs incubate in the gravel

Eggs hatch and fry emerge

Parr and smolts

Migrate to the ocean as a steelhead trout within the migration year tagged.

Feed and mature in the ocean

Adults return to natal tributaries

Steelhead Life Cycle (w/o kelts)

Photo credit: JK Boyer

Stay in freshwater and be a Rainbow Trout.

Stay in freshwater 1 – 3 additional years post-tagging, then migrate to the ocean as a steelhead trout.

migration year = July thru June

At what extent do our monitored *O. mykiss* delay emigration?

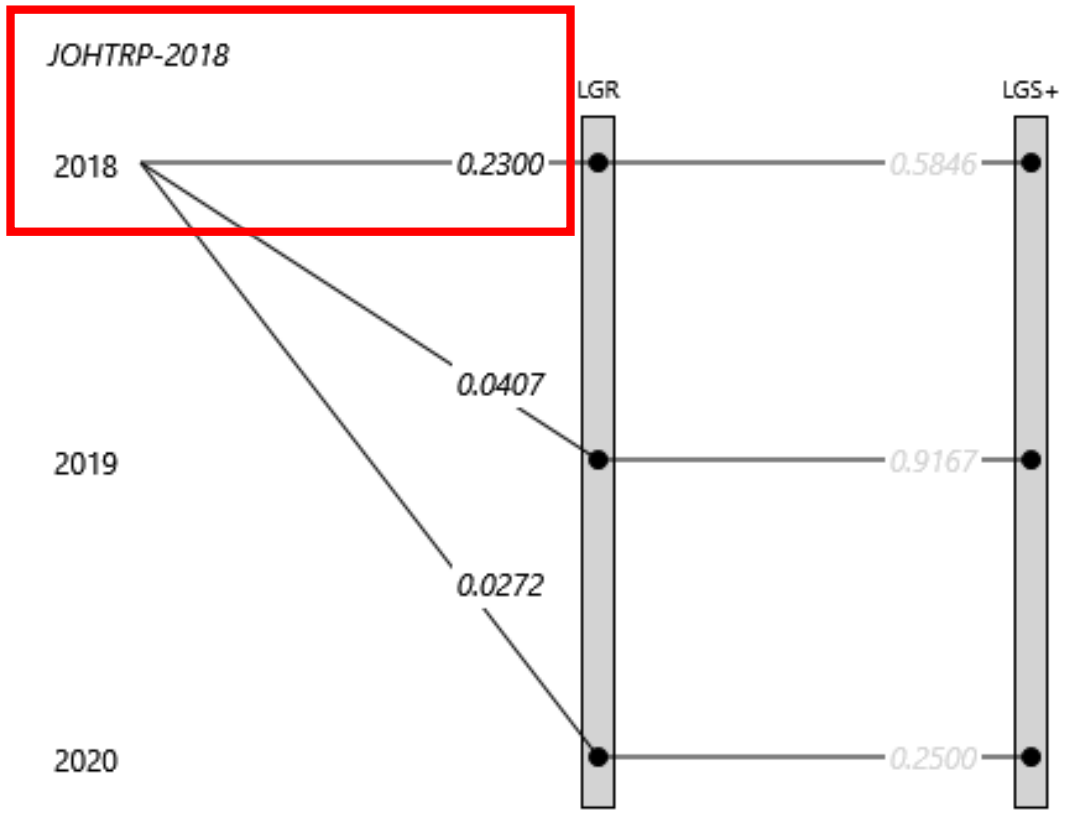
SECTRP (3 – 11%) and JOHTRP (3 – 12%) for MY2010-2021

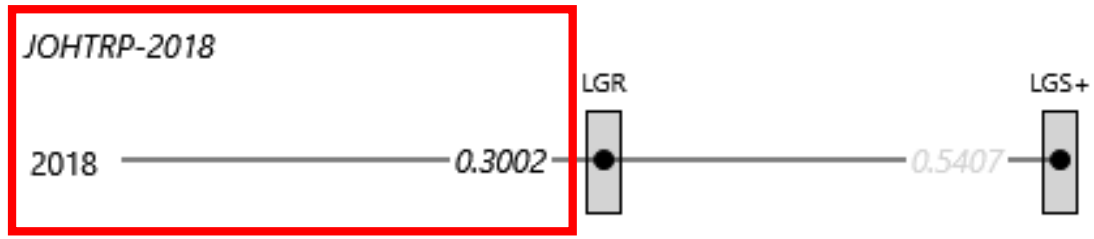
How to account for delayed emigration?

- **apparent survival to Lower Granite Dam**

  apparent survival (φ) -> the estimate does not distinguish between those animals that died and those that have appeared to leave the population (e.g., delayed migrants)

Basin TribPit





*underestimating apparent survival

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Methods in Ecology and Evolution Open Access BRITISH ECOLOGICAL SOCIETY

REVIEW

Machine learning and deep learning—A review for ecologists

Maximilian Pichler | Florian Hartig

Theoretical Ecology, University of Regensburg, Regensburg, Germany

Correspondence
Maximilian Pichler
Email: maximilian.pichler@biologie.uni-regensburg.de

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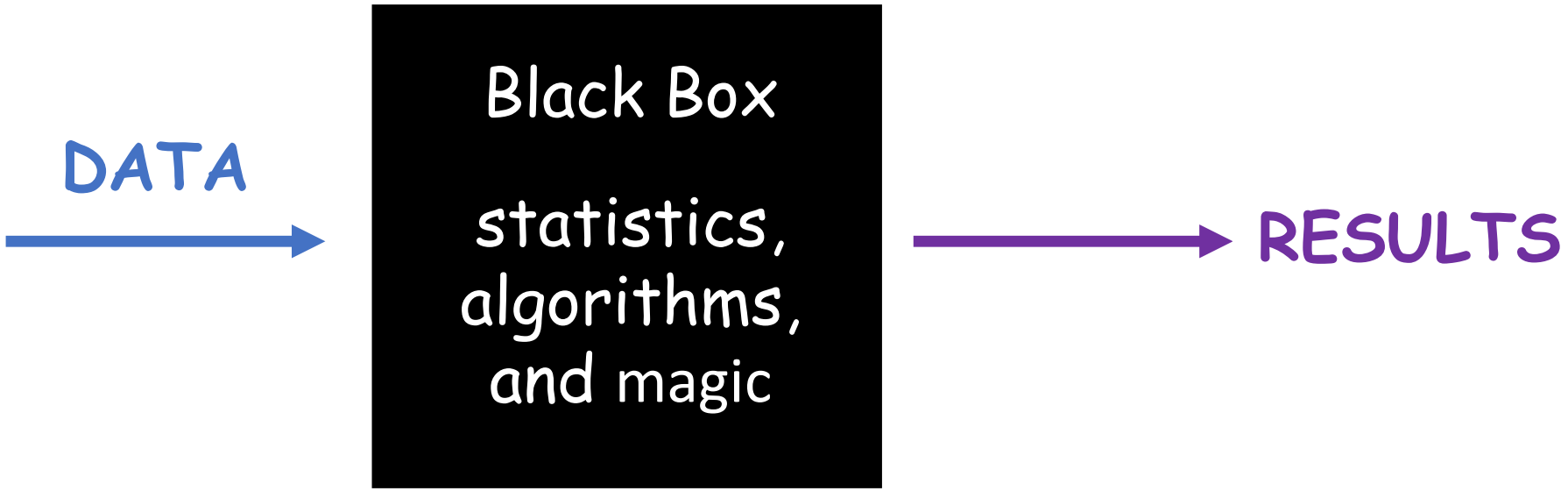
Abstract

1. The popularity of machine learning (ML), deep learning (DL) and artificial intelligence (AI) has risen sharply in recent years. Despite this spike in popularity, the inner workings of ML and DL algorithms are often perceived as opaque, and their relationship to classical data analysis tools remains debated.
2. Although it is often assumed that ML and DL excel primarily at making predictions, ML and DL can also be used for analytical tasks traditionally addressed with statistical models. Moreover, most recent discussions and reviews on ML focus mainly on DL, failing to synthesise the wealth of ML algorithms with different advantages and general principles.
3. Here, we provide a comprehensive overview of the field of ML and DL, starting by summarizing its historical developments, existing algorithm families, differences to traditional statistical tools, and universal ML principles. We then discuss why

thread
and
cloth

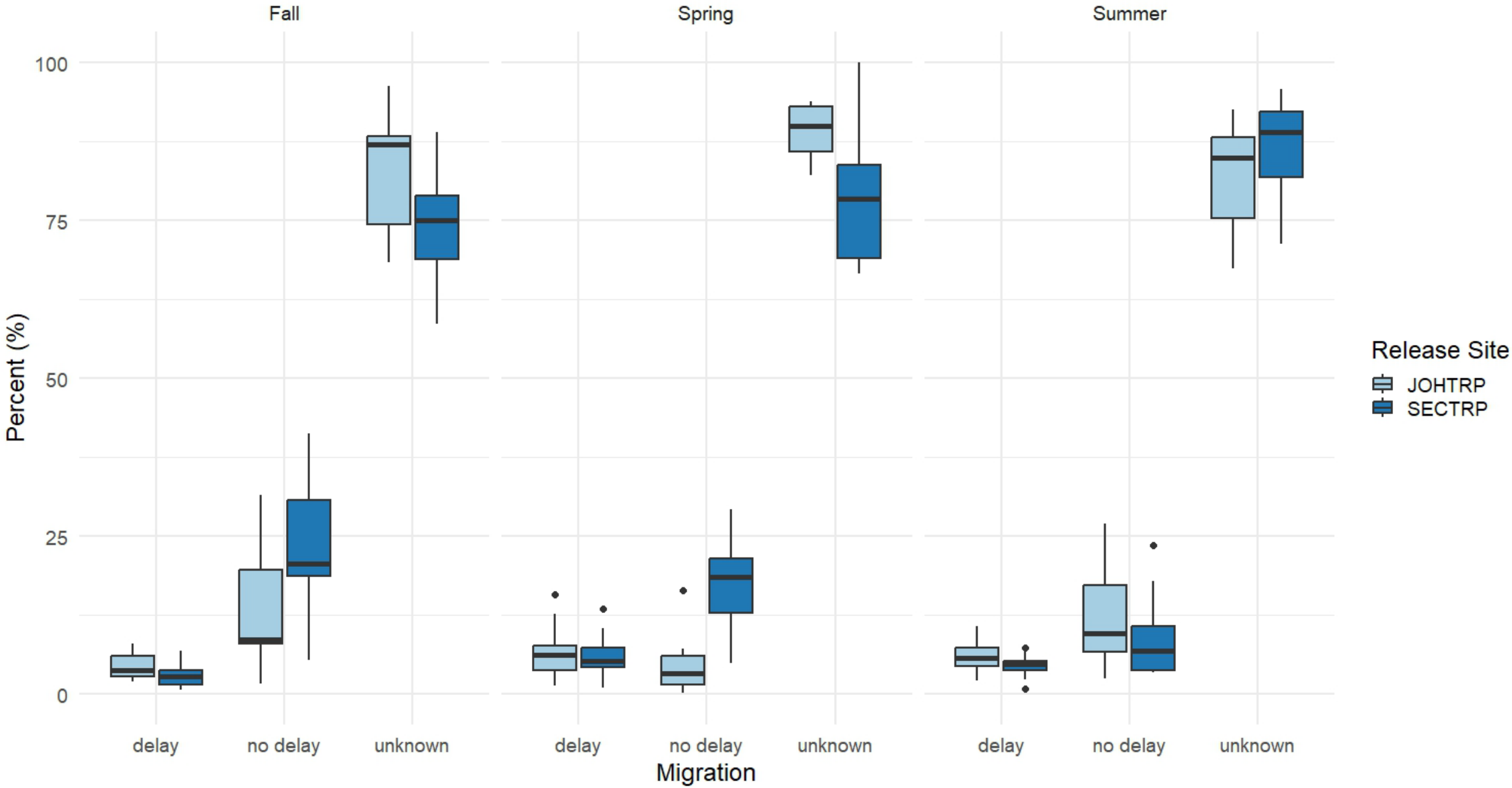
pillowcase

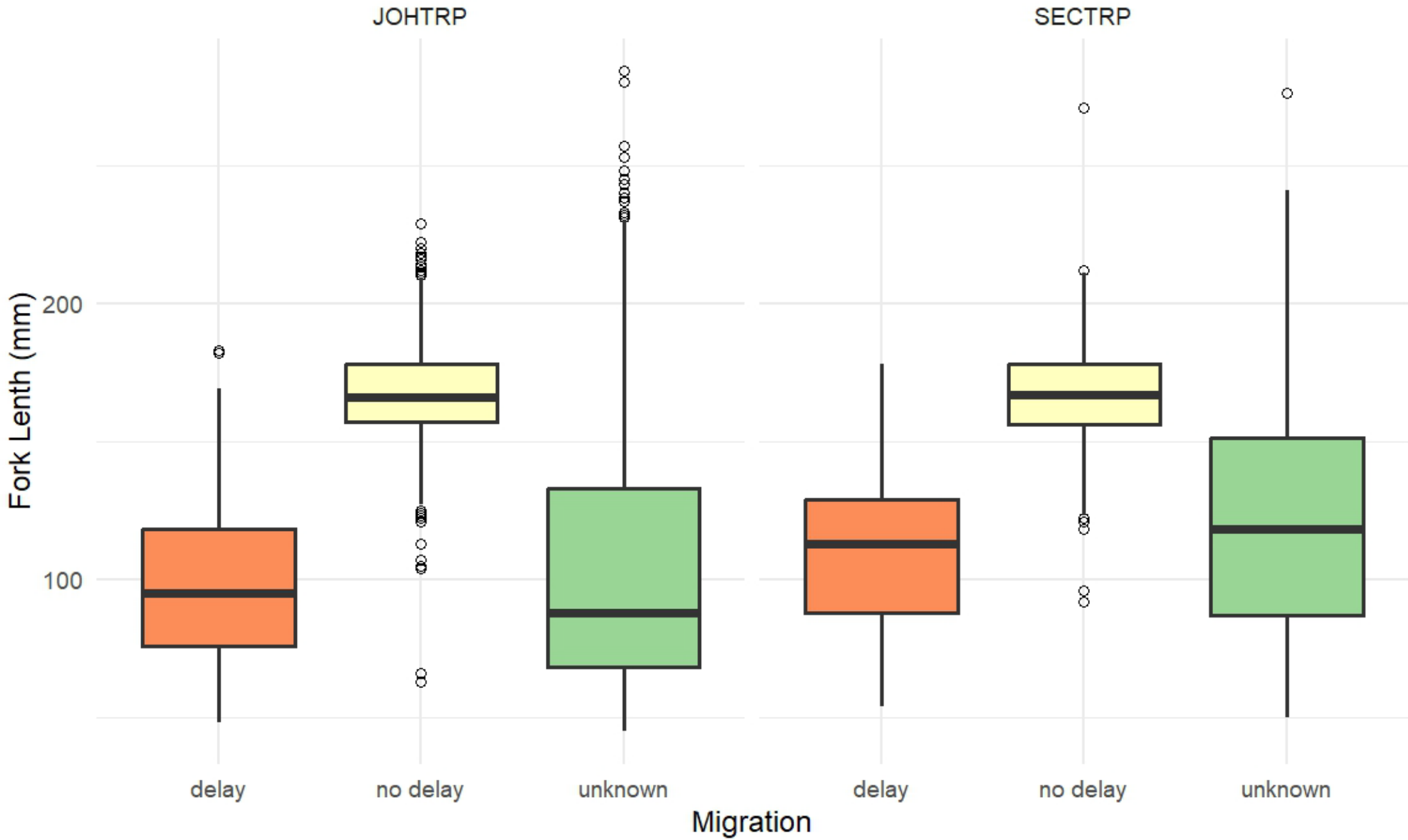

DATA
Black Box
statistics,
algorithms,
and magic
RESULTS

migration ~ release site + migration year + tag season + fork length

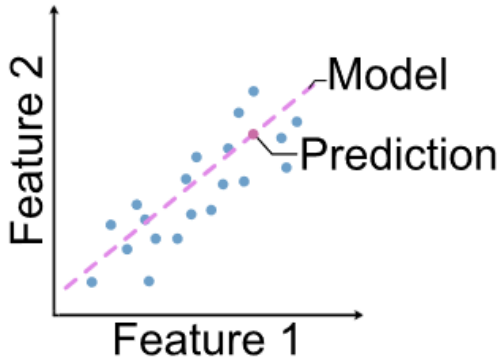
delay	JOHTRP	2010 – 2021	autumn	## mm
no delay	SECTRP	(factor)	spring	
unknown			summer	


2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
100
75
50
25
0
Percent (%)
JOHTRP
SECTRP
Release Site
Migration
delay
no delay
unknown


Fall
Spring
Summer
100
75
50
25
0
Percent (%)
delay
no delay
unknown
Migration
Release Site
JOHTRP
SECTRP

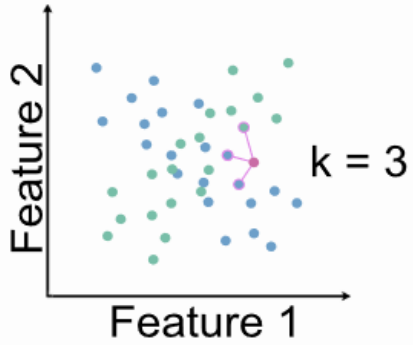

JOHTRP
SECTRP
Fork Lenth (mm)
200
100
delay
no delay
unknown
delay
no delay
unknown
Migration

LASSO, Ridge regression:



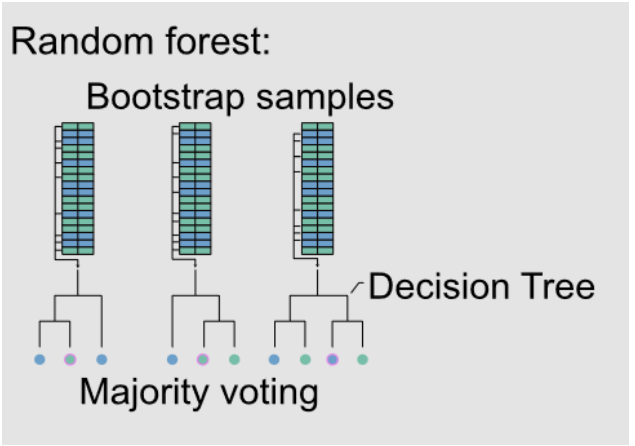
encourages simple, sparse models

k-nearest neighbor:



similarity of neighbors

collection of decision trees



Pichler and Hartig 2022

migration ~ release site + migration year + tag season + fork length

delay no delay unknown	JOHTRP SECTRP	2010 - 2021 (factor)	autumn spring summer	## mm

split data - 75% training; 25% testing

create dummy predictors

normalize numeric predictor (SD = 1, mean = 0)

tune hyperparameters (maximize model performance)

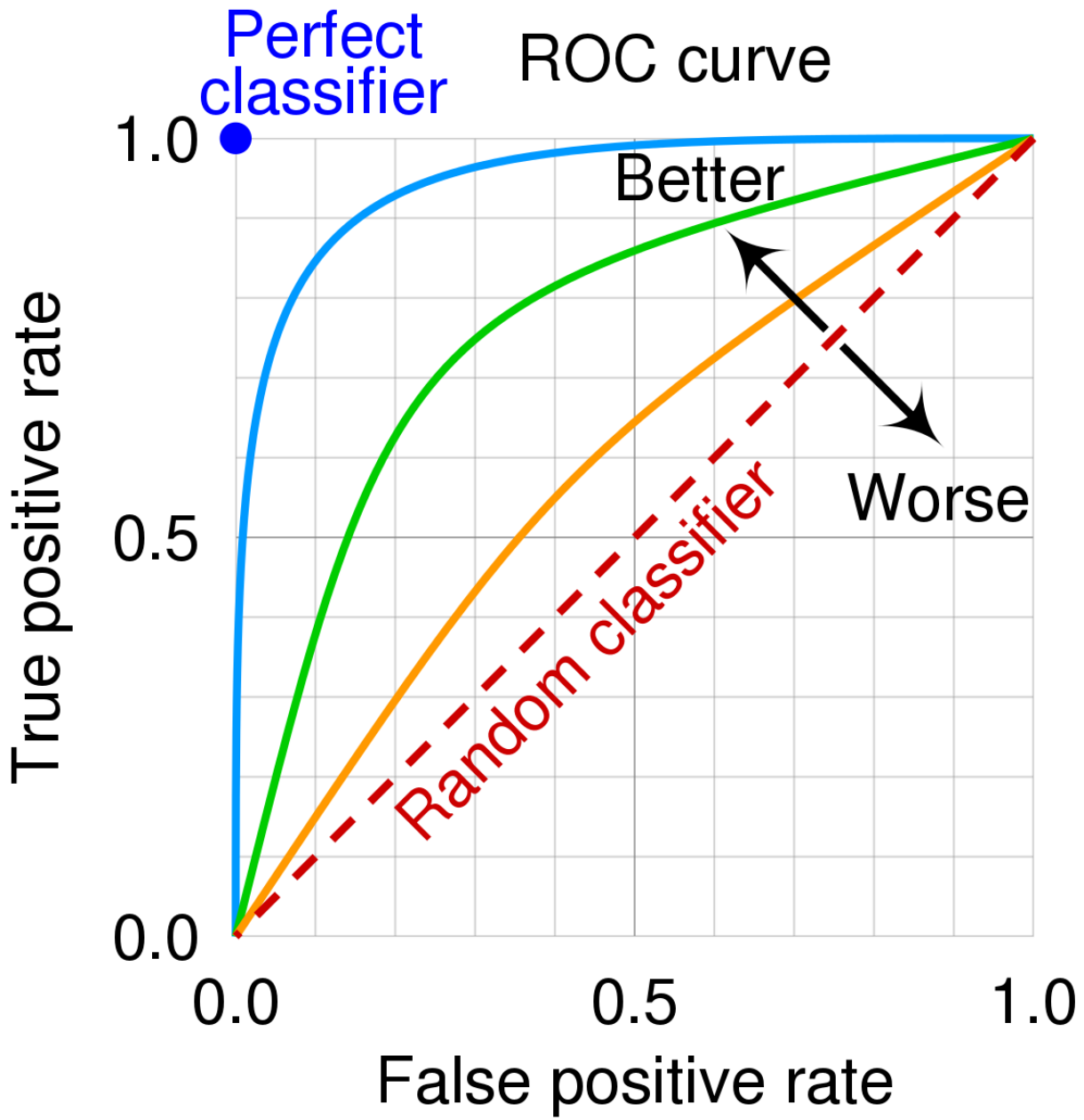
train the models

test the models

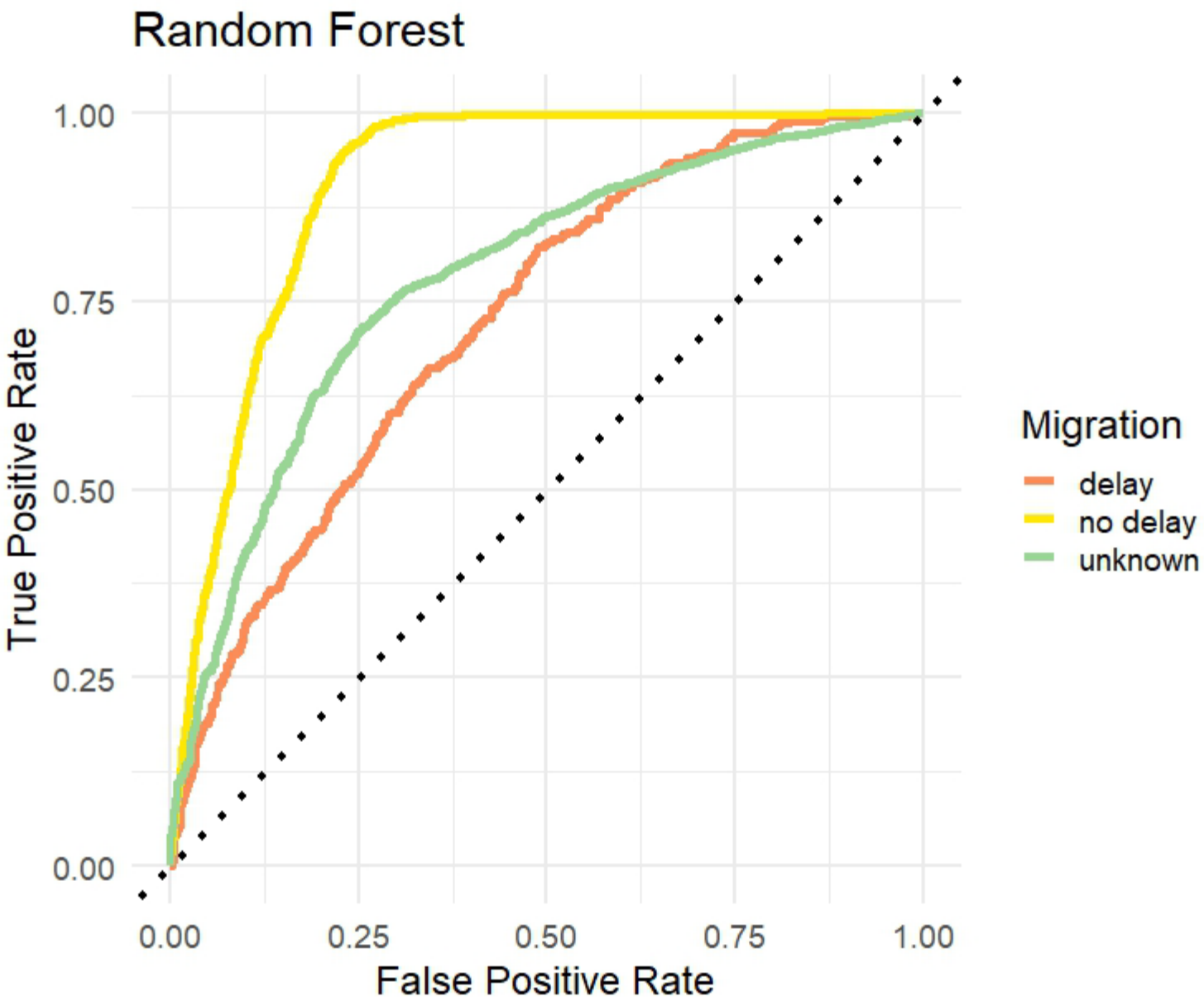
Model performance using the test data

multinomial classification – bit more complicated than binary classification

- one v. rest approach for ROC curves
- averaged AUC (0 – 1)
- accuracy (truth v. predicted, 0 – 1)
- variable importance



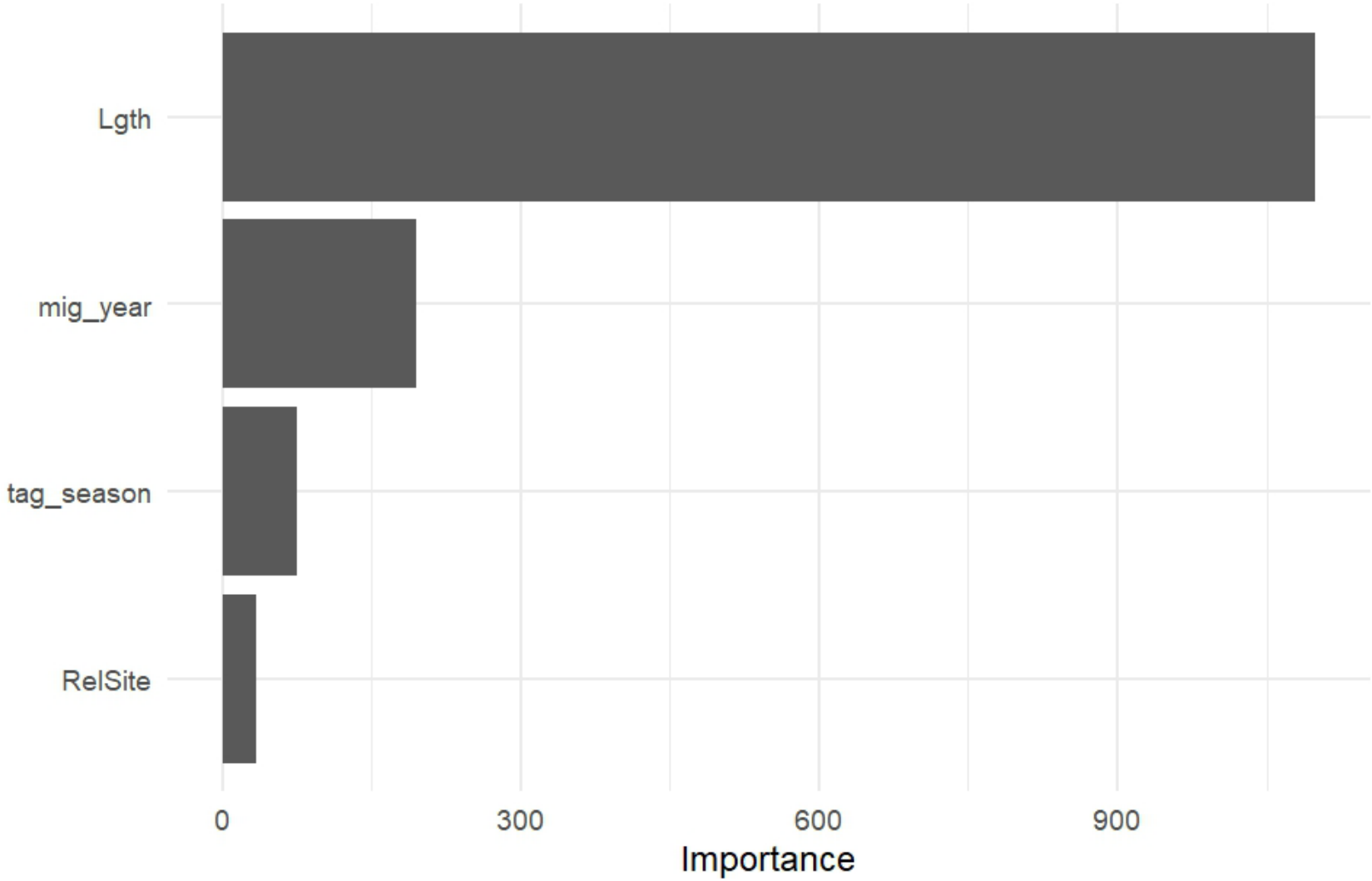
model output -> different probabilities for each migration class for a tagged *O. mykiss*



averaged AUC = 0.821

accuracy = 0.849

Random Forest – variable importance



Thoughts:

- low prevalence delayed emigrants and high prevalence of unknown emigrants

- predictors are not doing a good job at distinguishing between delayed and unknown emigrants
  - environmental predictors
  - density dependent predictors

- portion of "unknowns" that are Rainbow Trout

Next steps:

- refine our model predictors and response

- more advanced MLM

- other types of predictive models

- hurry up and wait – Basin TribPit

Photo credit: JK Boyer

Johnny 5 says: