

## 4th World Conference on Marine Biodiversity *Biodiversity, Computational Science*

# Automated identification of fishes in underwater images with Deep Learning algorithms



**Sébastien Villon**<sup>a,b</sup>, David Mouillot<sup>a</sup>, Marc Chaumont<sup>b,c</sup>, Emily S. Darling<sup>d,e</sup>, Gérard Subsol<sup>b</sup>, Thomas Claverie<sup>a,f</sup>, Sébastien Villéger<sup>a</sup>

- a MARBEC, University of Montpellier/, CNRS, IRD, Ifremer, Montpellier, France
- b LIRMM, University of Montpellier/CNRS, France
- c University of Nîmes, Nîmes, France
- d Department of Ecology and Evolutionary Biology, University of Toronto, Toronto, Canada
- e Marine Program, Wildlife Conservation Society, Bronx, United States
- f CUFR Mayotte, France













Coral reefs are increasingly impacted by global warming, pollution and overfishing . Monitoring of fish biodiversity can help to understand perturbation processes but need to be done over <a href="Iarge temporal">Iarge temporal</a> and <a href="Spatial">Spatial</a> Scales → New tools are urgently needed!

Coral reef fish biodiversity monitoring

Large number of fish to identify

Demanding
task + Limited
human
resources

How to improve new algorithms to identify fish species on images? How precise and fast are those algorithms compared to humans?

Use of videos to sample a large surface of reefs over a long time

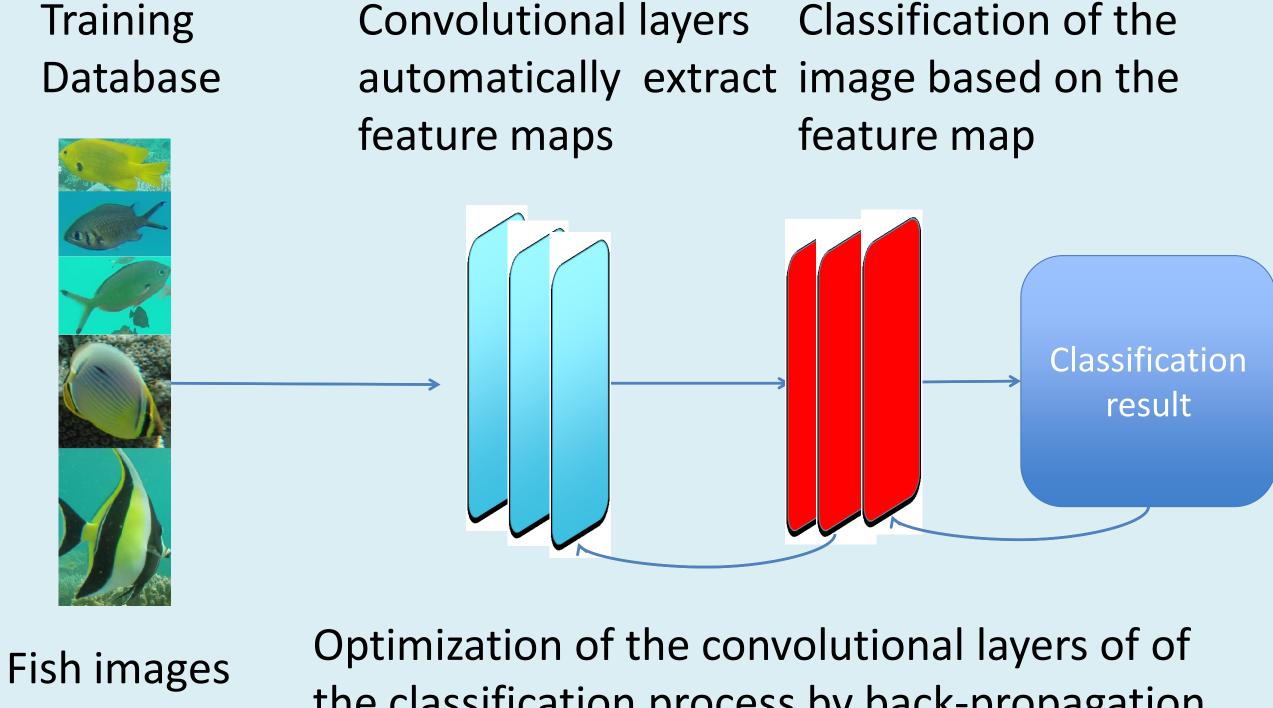
Need of automatic Identification



#### **Proposed methods**

Development of a Deep Leaning based method [1]

**How does Convolutional neural network training works?** 

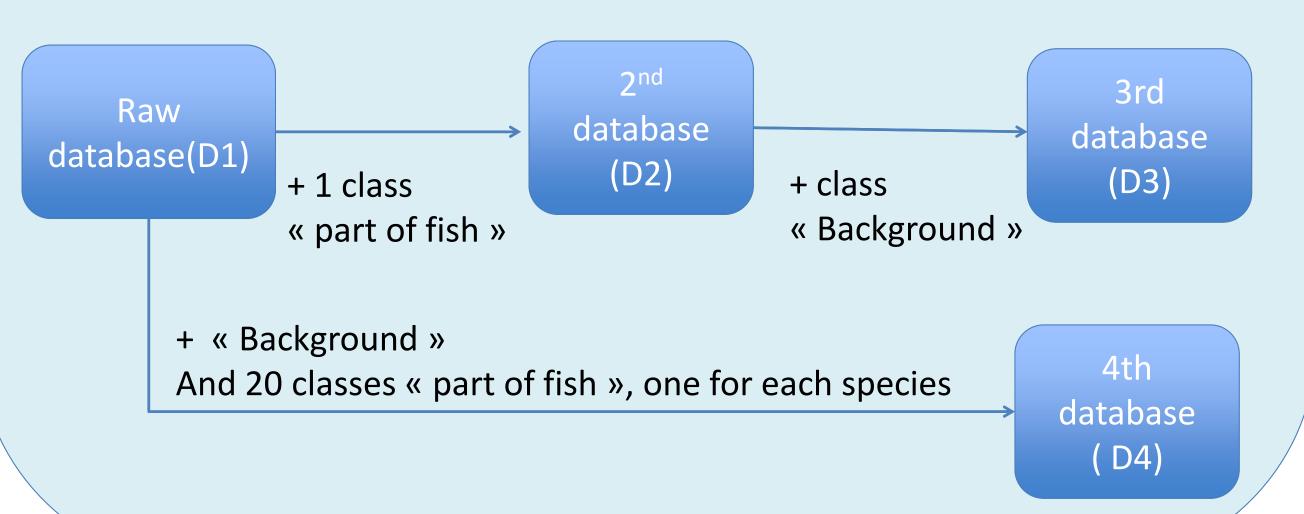


+ labels

Optimization of the convolutional layers of of the classification process by back-propagation on the training database

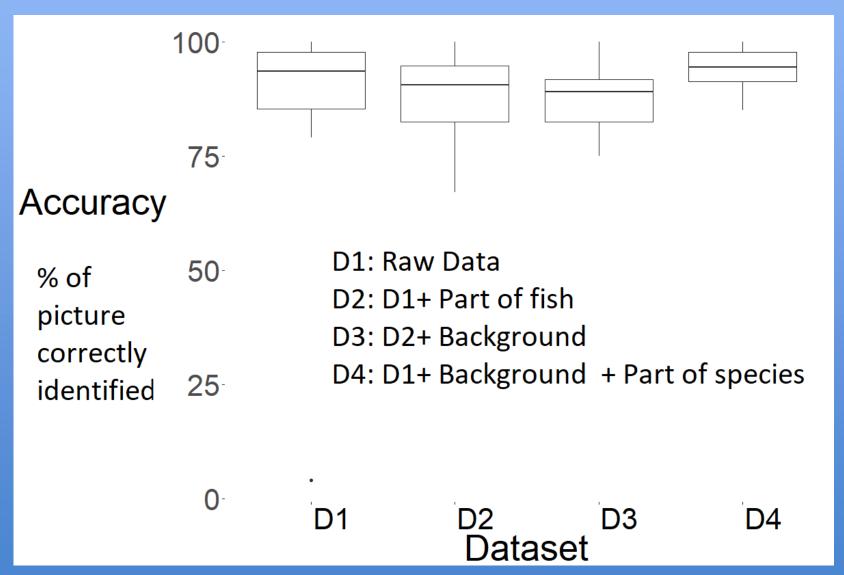
We trained a GoogLeNet architecture to obtain 4 models from our 4 databases. Models are tested on images from independent videos.

We built an image database D1 composed of **44,625** thumbnails of **20 fish species** from images manually cropped and identified. From this thumbnails database, we derived **4 training databases**:

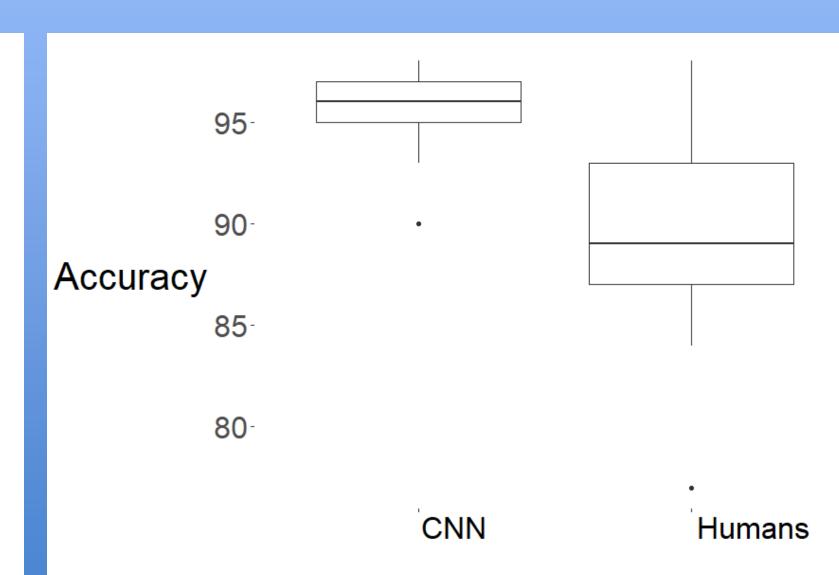


### Results

- Best results with database D4 ("Part of Fish" by species + Background)
- Mean accuracy = **94.1** % **on 20 species**
- Processing time: **0.06 s for a thumbnail**
- Compared to humans: 6% more precise (on 9 species) 100 times faster



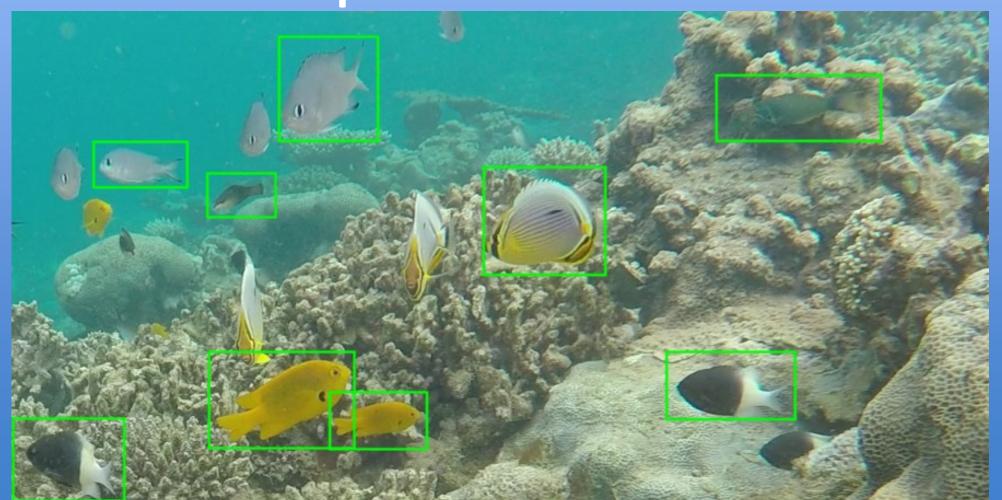
Results of the 4 models on 20 species



Results of human vs CNN comparison on 9 species

#### Perspectives:

Develop a localization algorithm to count individuals of each species in videos. We also need an increase of the number of learned species.



[1] Sebastien Villon, Marc Chaumont, Gerard Subsol, Sebastien Villeger, Thomas Claverie, David Mouillot, "Coral reef fish detection and recognition in underwater videos by supervised machine learning, ACIVS'2016