



# BEeS

## The LifeWatch ERIC Biodiversity & Ecosystem eScience Conference

Seville  
22-24/05/23



Threats and challenges to biodiversity and ecosystem conservation from an eScience perspective



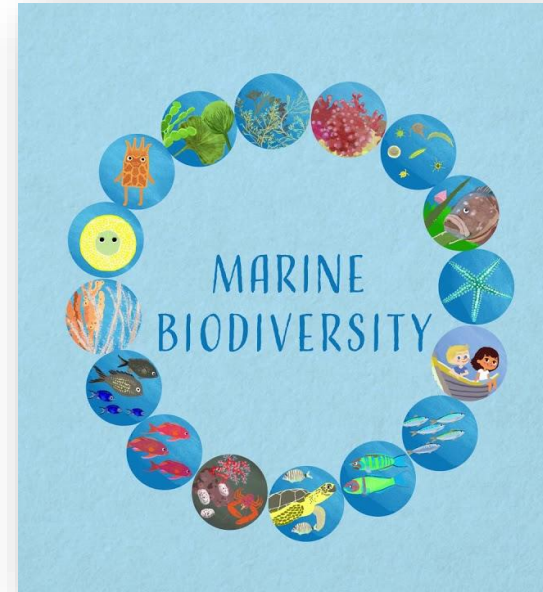
**UNIÓN EUROPEA**  
Fondo Europeo de Desarrollo Regional  
Una manera de hacer Europa

Long-term ecological research on marine hard-bottom communities  
using a network of genetic observatories,  
and introduction to the new LifeWatch workflow for data analysis

Speaker: Justine Pagnier

## The challenge

Monitoring marine biodiversity...



## The challenge

Monitoring marine biodiversity...

1. Over larger spatial and temporal scales



## The challenge

Monitoring marine biodiversity...

1. Over larger spatial and temporal scales
2. in complex habitats like rocky seafloors





**BEEs**

Seville, 22-24 May 2023

*Threats and challenges to biodiversity and ecosystem conservation from an eScience perspective*



*One solution...*

# Autonomous Reef Monitoring Structures (ARMS)



Pearman et al. 2018 Sci. Rep.



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*One solution...*

# Autonomous Reef Monitoring Structures (ARMS)



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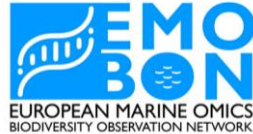
ARMS enable...

- **Standardized**
- **Non-destructive**

...sampling of benthic communities



# The ARMS network



# The ARMS MBON sampling campaign

**125** autonomous reef monitoring structures (ARMS)

**23** observatories

**14** countries

**3** years (2018-2021)



# The ARMS dataset



references to physical samples



metadata descriptions



images



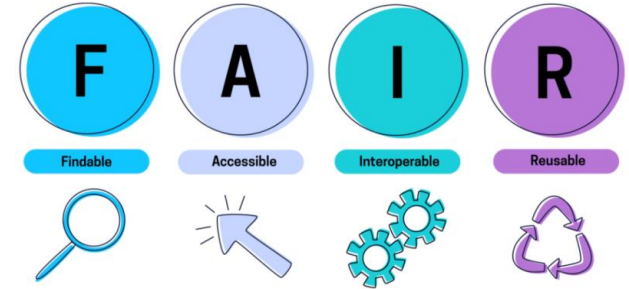
sequence data



derived species observations

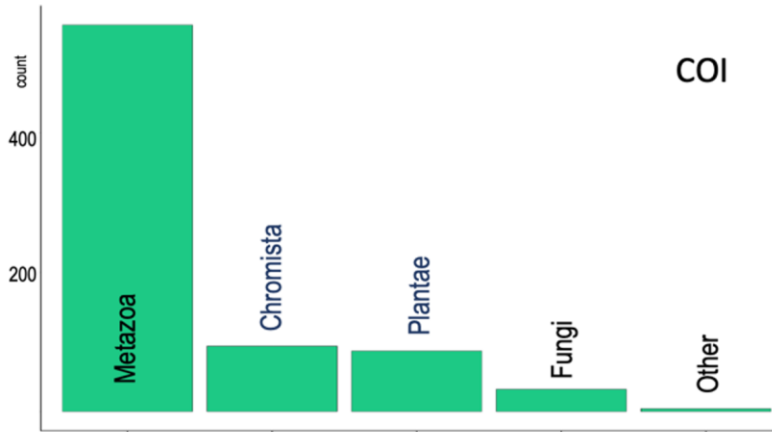


documentation of the analytical process

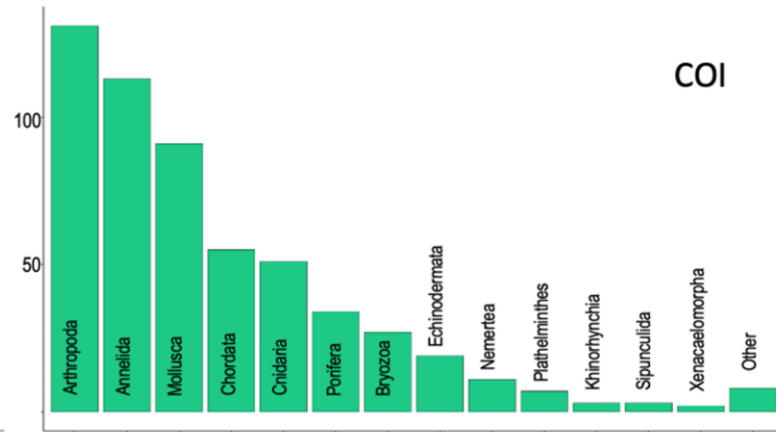


# Some results...

- *Distribution of identified species across taxa*



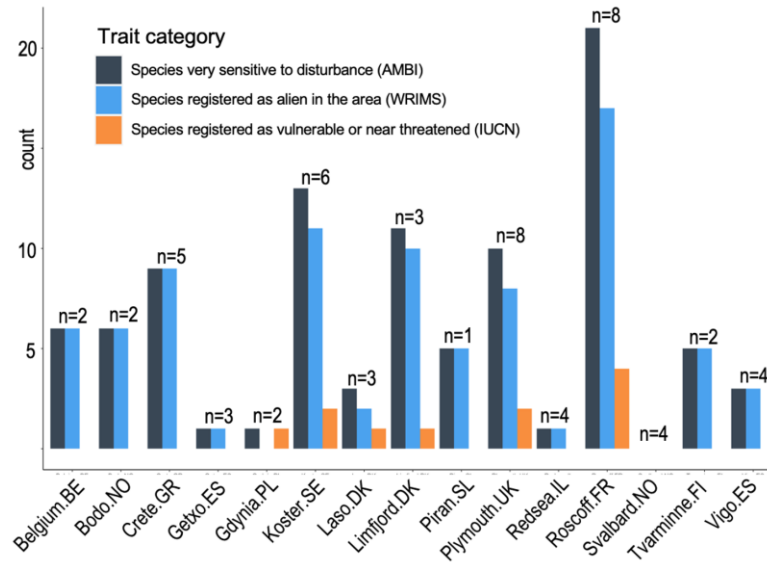
**Eukaryote**



**Metazoa**

# Some results...

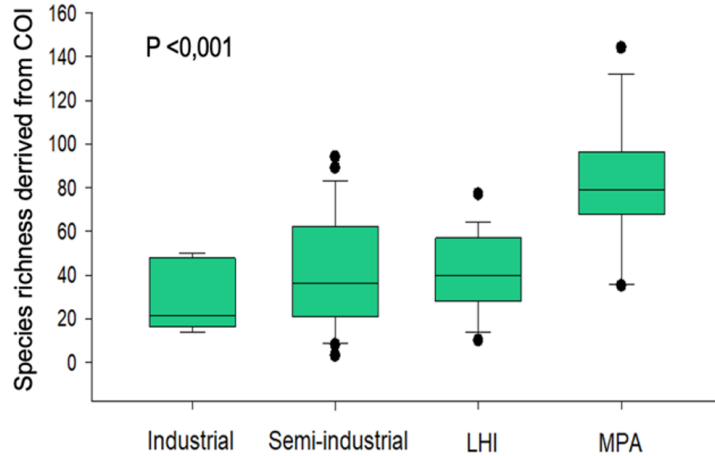
- *Number of identified species in 3 ecological groups across observatories*





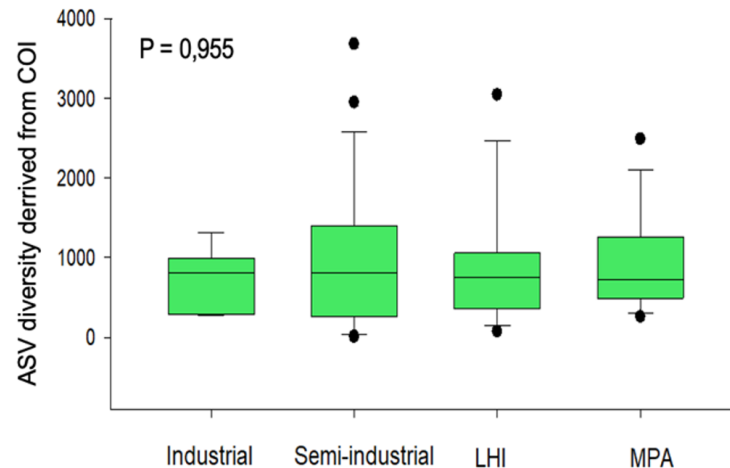
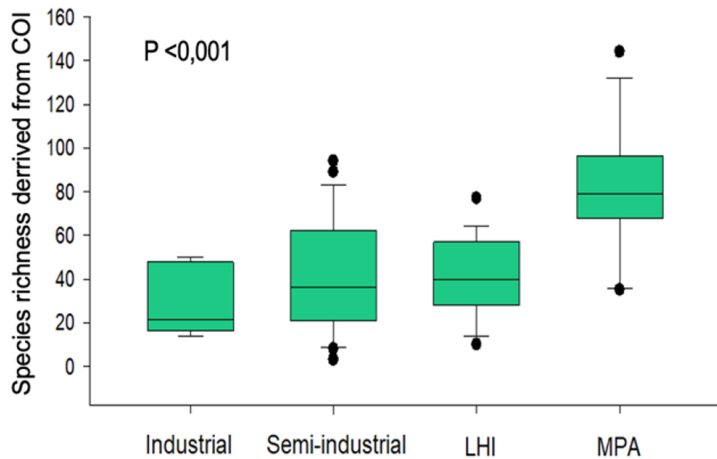
## Some results...

- *Diversity across a gradient of 4 habitat categories with different human footprints*



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- *Diversity across a gradient of 4 habitat categories with different human footprints*



ASV: Amplicon Sequence Variant



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# How to process all these genetic data efficiently?



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→ New [LifeWatch Internal Joint Initiative](#) workflow!

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→ New LifeWatch Internal Joint Initiative workflow!



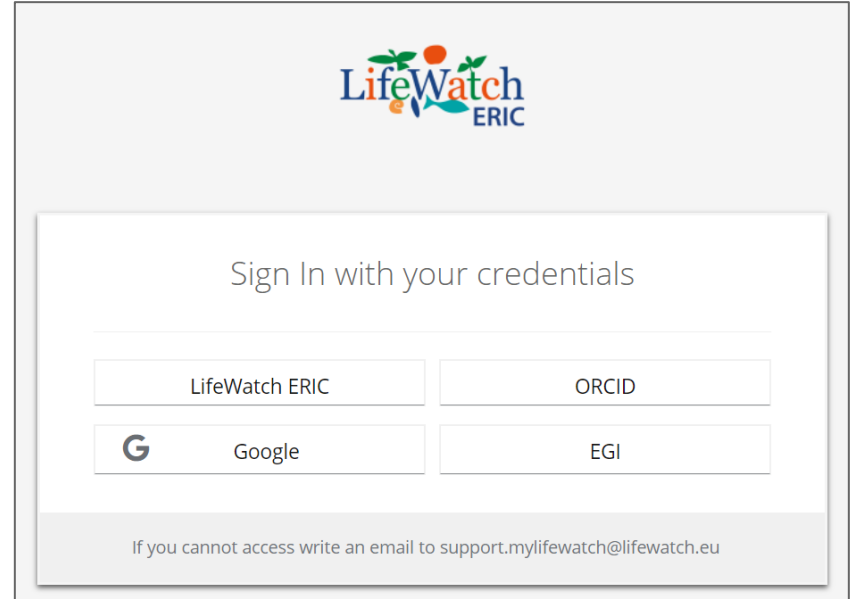
5 validation cases on Non-indigenous and Invasive Species  
... including ARMS!



# The LifeWatch IJI Workflow

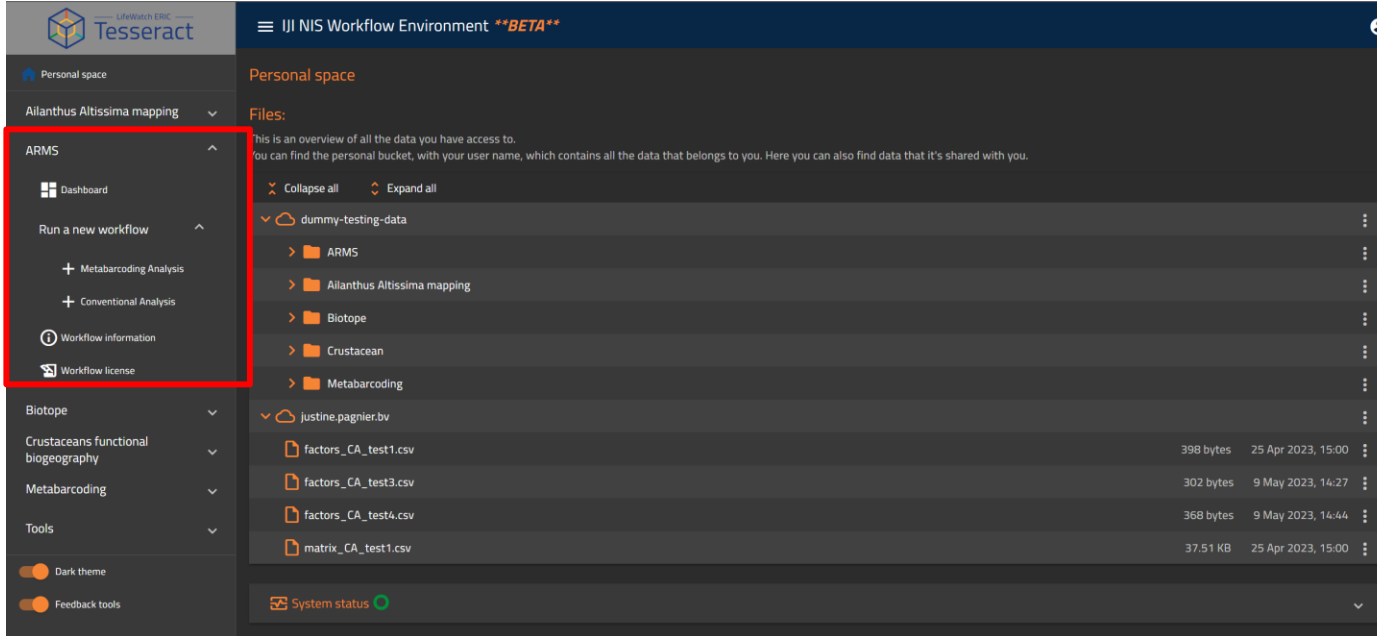
## The Tesseract Platform

*<https://tesseract.lifewatch.dev/personal-space>*



The screenshot shows the LifeWatch ERIC sign-in page. At the top right is the LifeWatch ERIC logo. The main heading is "Sign In with your credentials". Below this are four buttons for authentication: "LifeWatch ERIC", "ORCID", "Google" (with the Google 'G' logo), and "EGI". At the bottom, a grey bar contains the text: "If you cannot access write an email to [support.mylifewatch@lifewatch.eu](mailto:support.mylifewatch@lifewatch.eu)".

# The LifeWatch IJI Workflow



The screenshot shows the Tesseract IJI Workflow Environment interface. The left sidebar is highlighted with a red box and contains the following items:

- Personal space
- Ailanthus Altissima mapping
- ARMS** (highlighted)
- Dashboard
- Run a new workflow
  - Metabarcoding Analysis
  - Conventional Analysis
- Workflow information
- Workflow license
- Biotope
- Crustaceans functional biogeography
- Metabarcoding
- Tools
- Dark theme
- Feedback tools

The main content area displays the "Personal space" and "Files" section. It shows a list of folders and files:

- dummy-testing-data
  - ARMS
  - Ailanthus Altissima mapping
  - Biotope
  - Crustacean
  - Metabarcoding
- justine.pagnier.bv
  - factors\_CA\_test1.csv (398 bytes, 25 Apr 2023, 15:00)
  - factors\_CA\_test3.csv (302 bytes, 9 May 2023, 14:27)
  - factors\_CA\_test4.csv (368 bytes, 9 May 2023, 14:44)
  - matrix\_CA\_test1.csv (37.51 KB, 25 Apr 2023, 15:00)

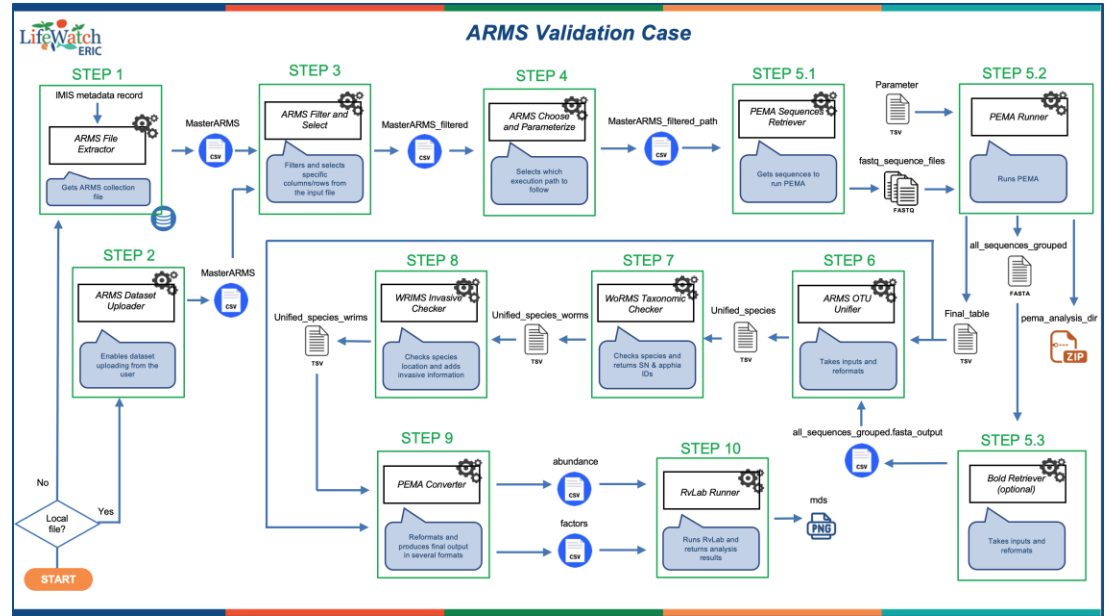
The system status is shown as "System status" with a green indicator.

# The LifeWatch IJI Workflow

- ◁ Metabarcoding analysis
- ◁ Conventional Community analysis

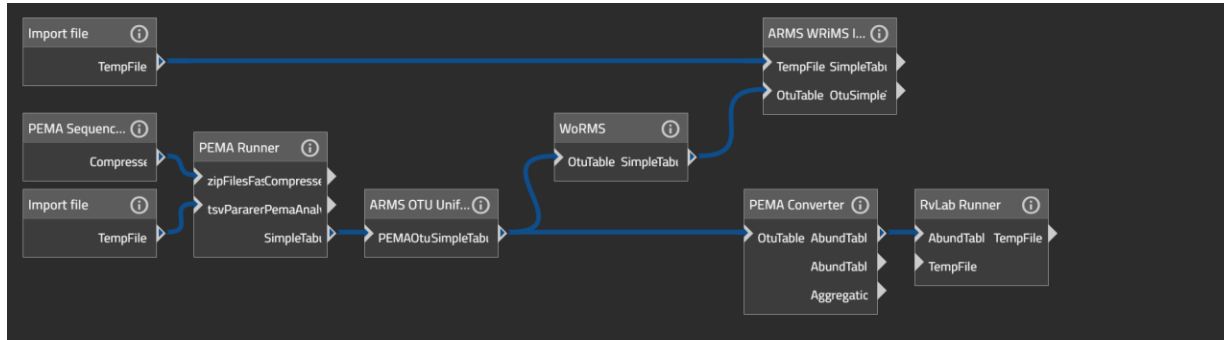
# The LifeWatch IJI Workflow

↳ *Metabarcoding analysis*



# The LifeWatch IJI Workflow

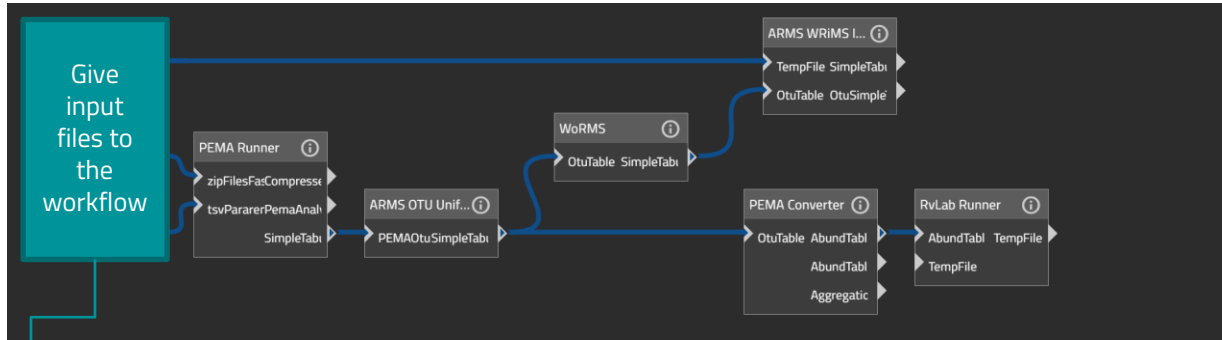
↳ *Metabarcoding analysis*





# The LifeWatch IJI Workflow

↳ *Metabarcoding analysis*

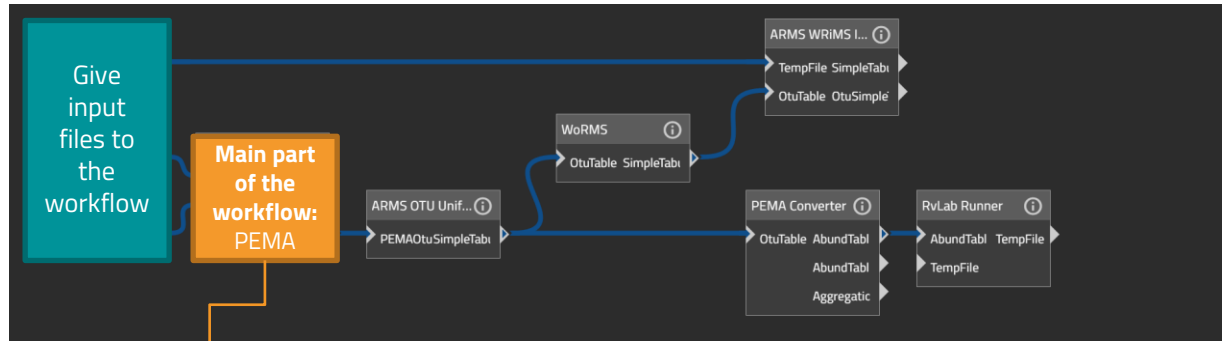


Steps 1, 2, 3, 4 and 5.1:

Chosen sequence files (fastq) are retrieved from ENA  
Parameters are chosen in the standardized parameters file

# The LifeWatch IJI Workflow

↳ *Metabarcoding analysis*

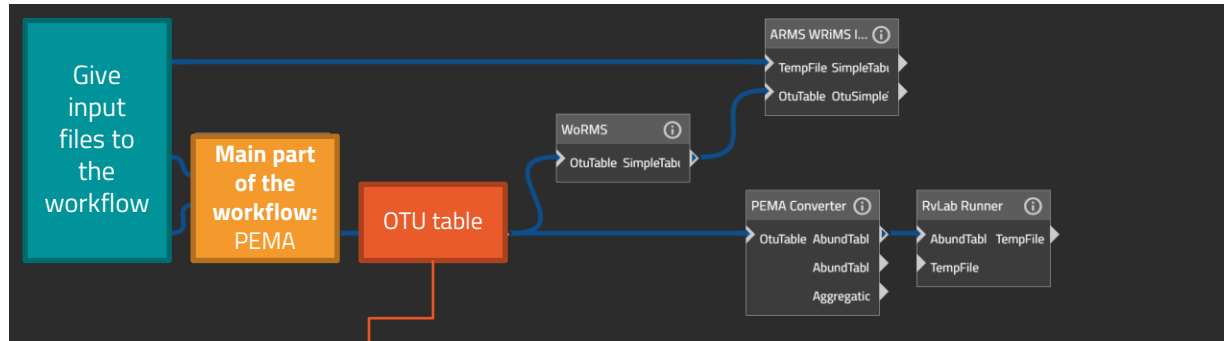


Steps 5.2 and 5.3:

DNA sequences are analyzed using Pipeline for Environmental DNA Metabarcoding Analysis (PEMA) for taxonomic identification  
 → 5 marker genes (12S/16S/18S rRNA, COI, and ITS) supported

# The LifeWatch IJI Workflow

↳ *Metabarcoding analysis*



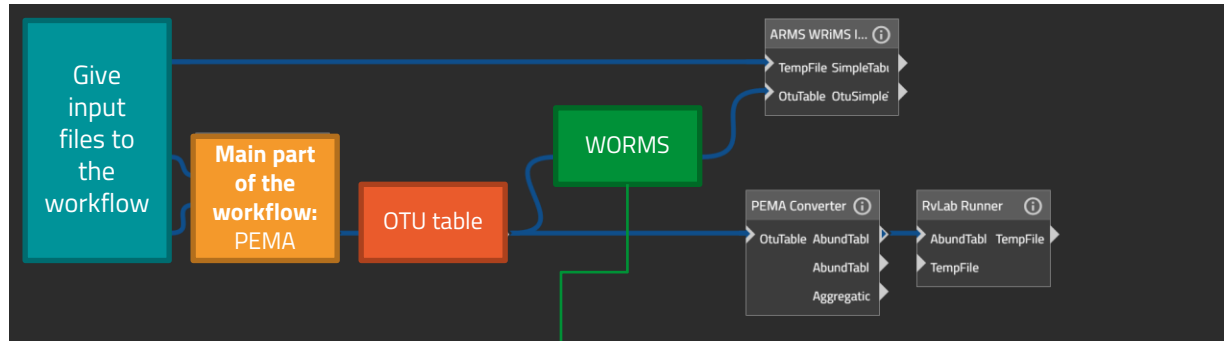
**Step 6:**

An OTU table with species information is built for downstream use

OTU: Operational Taxonomic Unit

# The LifeWatch IJI Workflow

↳ *Metabarcoding analysis*

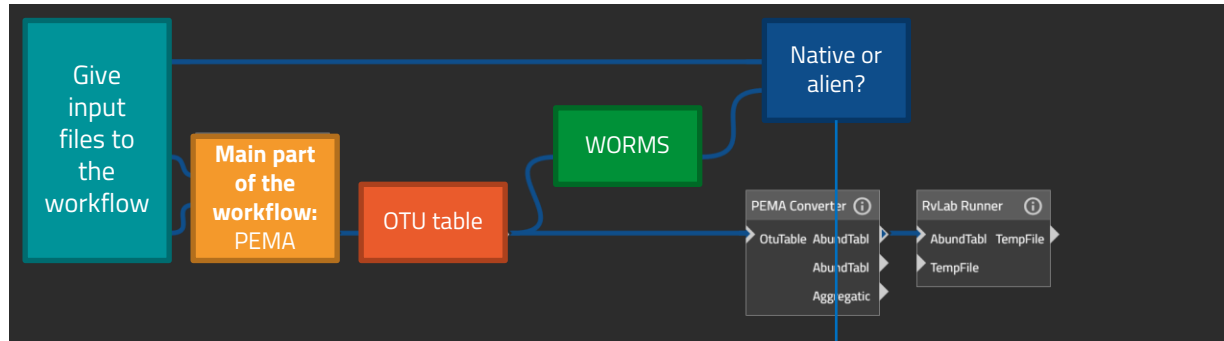


Step 7:

Check for the WORMS match to the obtain taxa  
Get the scientific name + aphia ID

# The LifeWatch IJI Workflow

↳ *Metabarcoding analysis*



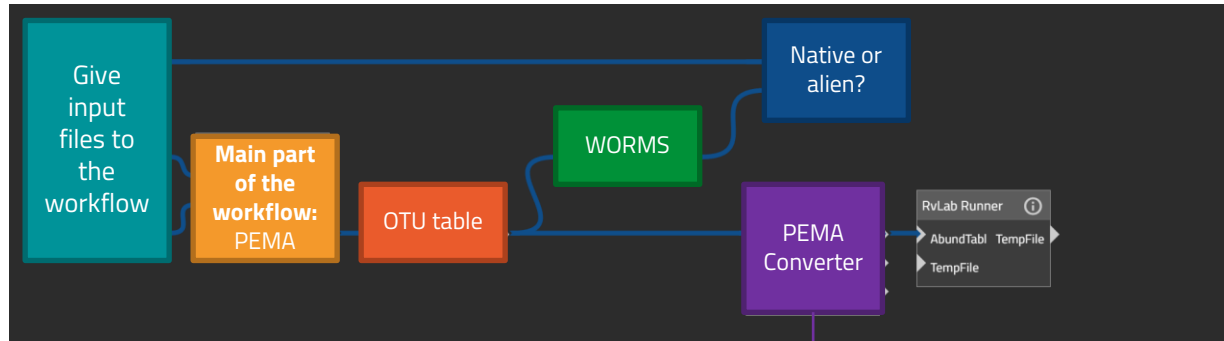
Step 8:

Check the known distribution of the species

Tells if the species is native or alien in the area where it was sampled

# The LifeWatch IJI Workflow

↳ *Metabarcoding analysis*

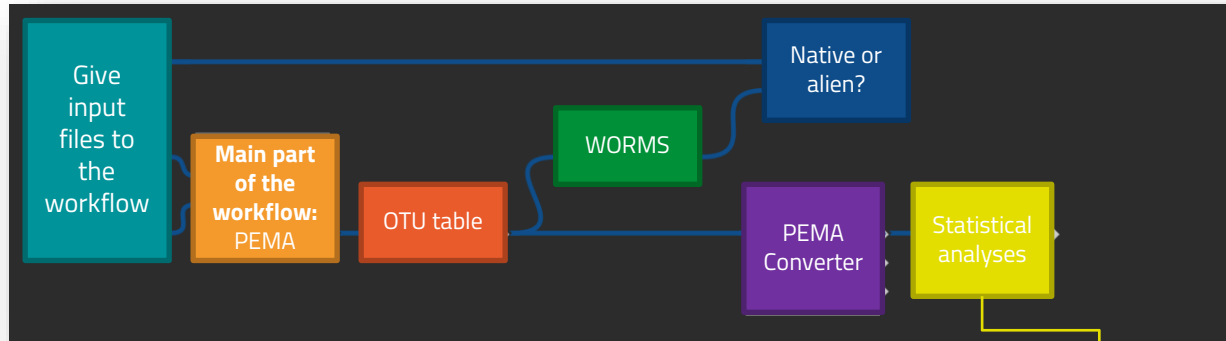


Step 9:

Converts final outputs in different formats

# The LifeWatch IJI Workflow

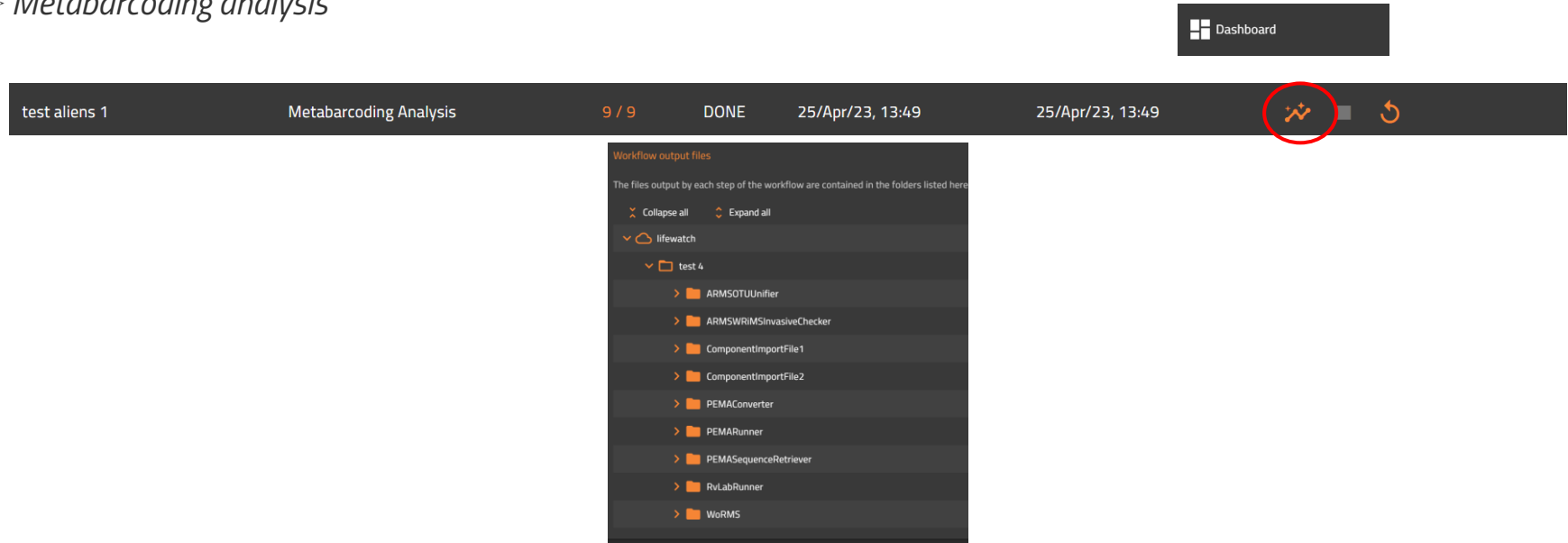
↳ *Metabarcoding analysis*



Step 10:  
RvLab allows various downstream ecological analyses  
(e.g. Multidimensional scaling)

# The LifeWatch IJI Workflow - Outputs

↳ *Metabarcoding analysis*



The screenshot displays the LifeWatch IJI Workflow interface. At the top right, there is a 'Dashboard' button. Below it, a dark navigation bar contains the text 'test aliens 1', 'Metabarcoding Analysis', '9 / 9', 'DONE', '25/Apr/23, 13:49', and '25/Apr/23, 13:49'. A red circle highlights a refresh icon in the top right corner of this bar. The main content area shows a 'Workflow output files' section with the text 'The files output by each step of the workflow are contained in the folders listed here'. Below this text are two buttons: 'Collapse all' and 'Expand all'. A tree view shows a folder named 'lifewatch' containing a sub-folder 'test 4'. Under 'test 4', there are several folders: 'ARMSOTUUnifier', 'ARMSWRIMInvasiveChecker', 'ComponentImportFile1', 'ComponentImportFile2', 'PEMAConverter', 'PEMARunner', 'PEMASequenceRetriever', 'RvLabRunner', and 'WoRMS'.



# The LifeWatch IJI Workflow - Outputs

<- Metabarcoding analysis

Dashboard

test aliens 1      Metabarcoding Analysis      9 / 9      DONE      25/Apr/23, 13:49      25/Apr/23, 13:49



OTU	ERR4914228	ERR7125478	ERR7125498	classification
5b7628ac4fba228a03d81385a0527c21a50fa83c	875	11296	0	D Eukaryota;Chnidaria;Anthozoa;Actiniaria;Sagartidae;Sagartia;Sagartia ornata
0df53f7d4b8f09fc78dd307820b68524ce74b681	3782	0	0	D Eukaryota;Annelida;Polychaeta;Phyllodocta;Nereididae;Cheloneires;Cheloneires cyclurus
59880e40fda653e7ac7505d46ffa37afced6295	4067	2	0	D Eukaryota;Annelida;Polychaeta;Phyllodocta;Sigalionidae;Sthenelais;Sthenelais boa
15e4929c8305101cc64e48e19ddef208af4f3d8b	5849	0	0	D Eukaryota;Arthropoda;Malacostraca;Amphipoda;Daglinotidae;Exhyalella;Exhyalella natalensis
640284627b77097c0f3b389cb04360380666b	0	860	0	D Eukaryota;Chordata;Actinopteri;Centrarchiformes;Kyphosidae;Labracloglossa;Labracloglossa argentivittis
89643548c53e7c118a72bd091cb851580a155a	805	4	0	D Eukaryota;Annelida;Haplotaxida;Naididae;Tubificoides;Tubificoides benedii
dcd19fd186e673f6642c9770fd96d603d9c4b69	982	48	0	D Eukaryota;Chordata;Actinopteri;Pleuronctiformes;Soleidae;Solea;Solea solea
4f148c6565611767ca777b12ef4d0a9f9a6d45	712	392	0	D Eukaryota;Chordata;Aves;Passeriformes;Hirundinidae;Hirundo;Hirundo dimidiata
8f481b9480c57576ef1a0ecd9f9404b2c979198	4	463	0	D Eukaryota;Chnidaria;Hydrozoa;Anthoathecata;Tubulariidae;Ectopleura;Ectopleura
055da2104cf949d44075d1a6e4e5fc78ebaaa92	180	494	0	D Eukaryota;Annelida;Polychaeta;Phyllodocta;Syllidae;Odontosyllis;Odontosyllis
716447977511d9cd27b5c490e947cca21d6829c	596	22	0	D Eukaryota;Bryozoa;Gymnommatida;Cheliosomatida;Electridae;Conopeum;Conopeum
387814e530f7144134ea082431a6c0ba0becb6	1373	0	0	D Eukaryota;Mollusca;Gastropoda;Clausiliidae;Albinaria;Albinaria boreomiei
ef3520653a22800f1f0dc725dc9f93a6d74330	0	259	0	D Eukaryota;Chordata;Actinopteri;Chaetodontiformes;Chaetodontidae;Chaetodon
c3b2e9a5650254478bdc6a68183103300b95d4	372	0	0	D Eukaryota;Chordata;Mammalia;Dasypodomorphia;Dasyporidae;Micromurexia;Micromurexia
e539a32e48e111cdf05030c600575345a0174b0	66	115	0	D Eukaryota;Chnidaria;Hydrozoa;Anthoathecata;Tubulariidae;Ectopleura;Ectopleura
e5fa10b848e49652b1832bd8ada6a9b46a4291a	155	0	0	D Eukaryota;Chordata;Actinopteri;Siluriformes;Bagridae;Pseudobagrus;Pseudobagrus
6024604343c814720e07c75760030c731a8ab6f	0	75	0	D Eukaryota;Platyhelminthes;Rebdyridae;Callinellidae;Rebdyridae;Rebdyridae

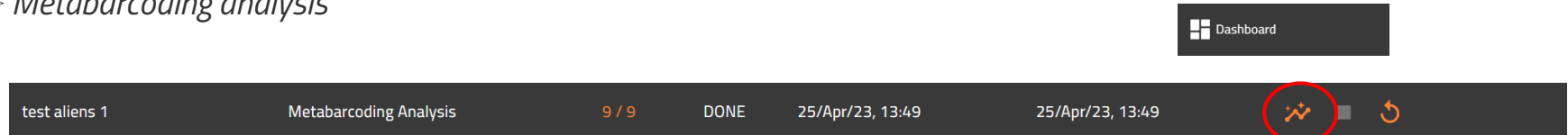
← OTU table

```
>259f85d1c6b938ba626a5f807384680aed641630_17996
GGTACTGGTGAAGTGTTTATCCTCGGTCTGGTGTATCTTCGGCCACCCGAGGCTACTGTCTCTTATACACATCTCGGAGCCACGAGACATCTCAGGATCGTATGCGCTCTTCTGCTTGAAAAAAAAGGACCCACCCAGGATCTACAC
TTCTAGCTTCTGGCCAGGTCAGATGTGTATAGAGACAGGATGCTGGTGAACCTGTTATCTCGTCTGGTATTCTGGCCACCCCGAGGCTCTA
>5bf628ac4fba228a03d81385a0527c21a50fa83c_12171
TTTATCCGGTATCAACACACTCGGAGGGGGCTGATAGCCATTTTGTCTTCACTAGCGGGTCTTCTATTTTGGGGCAATGAATTTTATAACGACTATTTAATAGAGGGCTCCAGGAATGACAATGGACGACTTCCA
TTATTTGATGCTTATTTAATCTAGCTTTTATTTGCTCTTCACTGTTTATGACGAGGATTAAGTATTTTAAACAGATAGGAATTTTAAACCACTCTTTGATCGCCGGGGGGTGGAGCCCTTTTATCCAACATT
TATTT
>15e4929c8305101cc64e48e19ddef208af4f3d8b_5849
TCTGCCCCACCGTGGCTCATTATGGCAGTGTAGACTAGTACTTTTCTCTTTACATTTAGCCGGGGCTTCTGATCTGGGGGCAATTAATTTTCTCAACAGTAATCAACATCGGGCACCAGGAATAACTTTGACCGGAATGCCT
TTATTCGTGGTCTGTTATTTAAACGCCATCTTTTACTTACTCTTTACCCGTTTTAGCAGGAGCTATCACTATGTTTAAACAGATCGAAACCTTAATCTCTTTTTGACCCCTTGGGAGGGGTGACCCCTTTTATACCAACTT
TATTT
>59880e40fda653e7ac7505d46ffa37afced6295_4069
ATTGGCGTCAATCTGCTCAGCAGGGCCATCTGAGACTAGCACTTCTCCCTCACACATGACGGGGCTCTCAATTTGGAGGCCATAAATTTTCAACAGTATTAATTAATGCGTTACAAGGGCTACGATTAAGAGGGTCCCC
CTATTGATGGGAGCATAAATACAGCTATCTTCTCTCAAGCTTCCAGTACTGACGGGGGCTACCACACTCTGACTGACCGAAACTAAATGACTGCTT7TACCCAGCTGGGGGAGGATGCAATTTCTTACCAACCC
TCTTT
>0df53f7d4b8f09fc78dd307820b68524ce74b681_3782
ACTATCCAGAAACATCGCCACGAGGAGCGTGGTAGCTGGCACTTCTCTCCCTCACTAGCGGGGGTCTCTTATGAGGGCCCTAAATTTTCAACAGACTAATCAACAGCTATAAGGGCTACGCTAGAGGAACTCT
```

Fasta file of all sequences →

# The LifeWatch IJI Workflow - Outputs

↳ Metabarcoding analysis



test aliens 1      Metabarcoding Analysis      9 / 9      DONE      25/Apr/23, 13:49      25/Apr/23, 13:49

Dashboard

⚙️ ↻

- 1.qualityControl
- 2.trimmingSequences
- 3.adjustingSequences
- 4.mergingPairedEndFiles
- 5.dereplicateSamples
- 6.linearizedSequences
- 7.mainOutput
- 8.outputPerSample
- checkpoints\_for\_test\_COI\_midori1
- parametersOf.test\_COI\_midori1

← Zip file with all outputs from PEMA

Log file for each step →

```
[DEBUG] [2023-03-29 12:29:41.779630] Running task 4270a225-1b97-4163-9067-  
[DEBUG] [2023-03-29 12:29:41.779787] Importing function from drama_iji.cat  
[DEBUG] [2023-03-29 12:29:41.843381] Declared input tasks (1): ['PEMAConve  
[DEBUG] [2023-03-29 17:30:30.641075] Got message from PEMAConverter  
[DEBUG] [2023-03-29 17:30:30.641459] Received PEMAConverter.AbundTable fro  
[DEBUG] [2023-03-29 17:30:30.641625] PEMAConverter content: {'resource':  
'delimiter': ',', 'encoding': 'utf-8', 'file_format': 'csv'}  
[DEBUG] [2023-03-29 17:30:31.059141] Got message from PEMAConverter  
[DEBUG] [2023-03-29 17:30:31.059479] Received PEMAConverter.AbundTableNoD  
[DEBUG] [2023-03-29 17:30:31.059572] Discarding message PEMAConverter.Abun
```

# The LifeWatch IJI Workflow - Advantages

- **can run PEMA on LW resources:** no need to install yourself

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- **can run PEMA on LW resources:** no need to install yourself
- **can run PEMA over and over:** easy to test out different permutations of parameters
- **can keep results in your dashboard:** easy to go back and look at them again

## Future plans



Using the **LifeWatch IJI workflow**  
to run **PEMA**  
on extensive amount of **ARMS** data

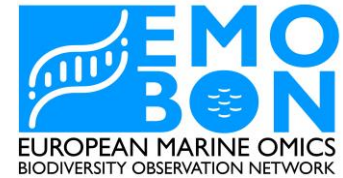
# Acknowledgments

LifeWatch (<https://www.lifewatch.eu/>)

ARMS MBON ([www.arms-mbon.eu](http://www.arms-mbon.eu)) & members

EMBRC, through EMO BON (<https://www.embrc.eu/emo-bon>)

AssemblePlus (<http://www.assembleplus.eu/>)



Matthias Obst, Katrina Exter & Christina Pavloudi



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Thank you! | [www.lifewatch.eu/bees-2023](http://www.lifewatch.eu/bees-2023)

