

EUROFLEETS+ Floating University

“State and sustainable use of the ocean biological resources:
the case of the *Nephrops norvegicus* (Norway lobster)”

Onboard the R/V Mário Ruivo

Portugal, June 15 – July 5



Eurofleets+

An alliance of European marine research infrastructure
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NORWAY LOBSTER

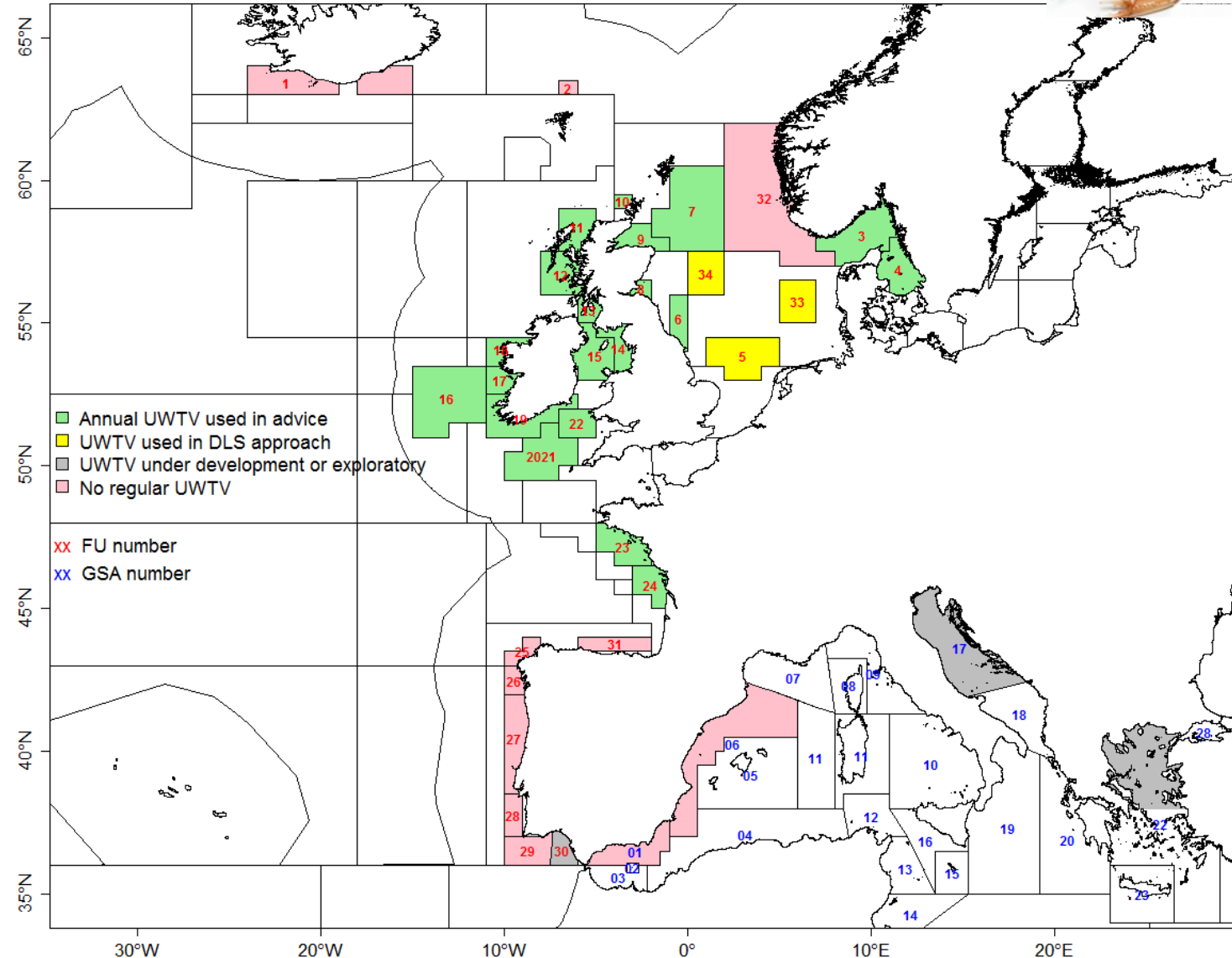
Nephrops norvegicus (Linnaeus, 1758)



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- ✓ **Widely distributed** in the NE Atlantic and Mediterranean, from Iceland and Norway in the north to Morocco and Greece in the south
- ✓ Absent from the Baltic and Black Sea and the Levantine coast.
- ✓ **Continental shelves and slopes** (20 – 800 m)
- ✓ **Habitat:** muddy sediments with >40% silt
- ✓ **Assessment:**
 - ✓ ICES area: by Functional Unit (34 FUs)
 - ✓ GFCM (Mediterranean Sea): by Geographical SubAreas (GSA)



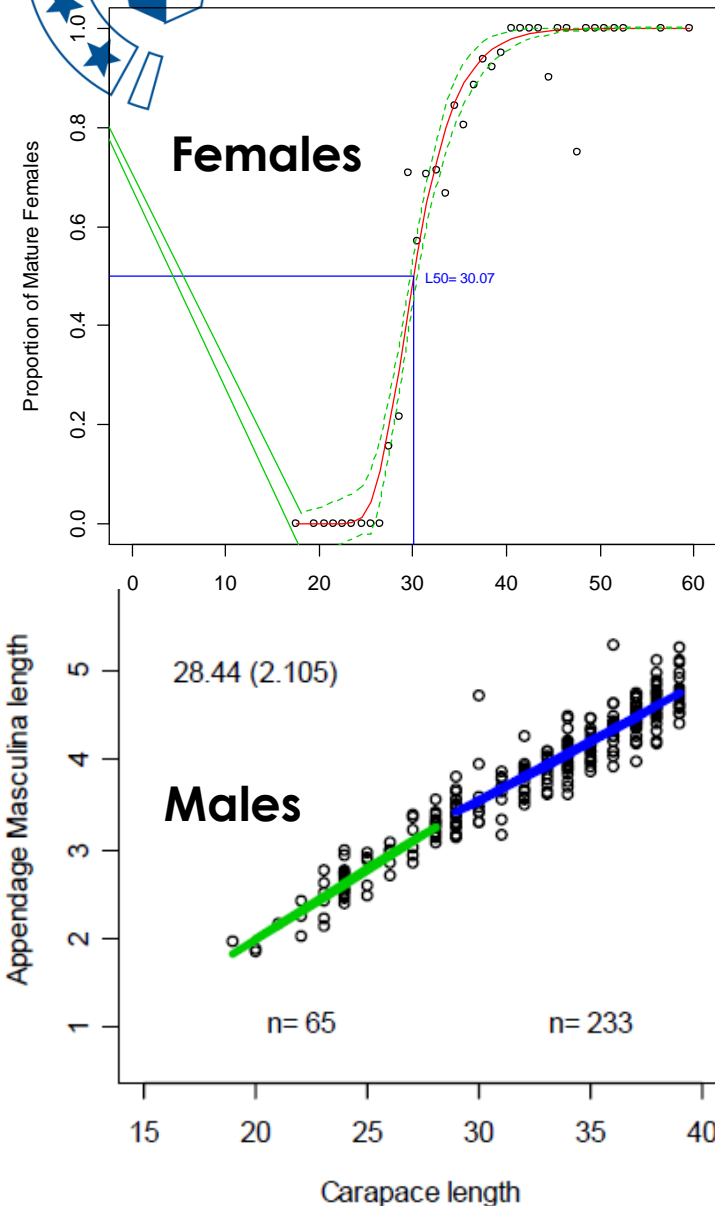


GROWTH



- ✓ **Moulting frequency** (after having passed to the benthic stage):
 - 1st year: juvenile 1 moult/month
 - 2nd and 3rd years: 3 -4 moults/year
 - After onset of sexual maturity: M: 1-2 moults/yr; F: 0-1 moults/yr
- ✓ **Size at age – No hard structures to determine age**
 - Modal progression
 - Tagging (expensive, low rate of recapture)
- ✓ Different **growth rates** depending on temperature, sediment particle size, food availability, population density, fishing pressure, etc.)

FU 29 (06/2004)



REPRODUCTION

✓ Size of first maturity (L_{50})

- **Females:** L_{50} between 23 and 30 mm, depending on the stocks (based on ovary maturation, presence of spermatophores, ovigerous females). Age of maturity around 3 – 3.5 yrs (Portugal L_{50} ~30 mm CL)
- **Males:** L_{50} based on allometric changes in the morphology of the appendix masculina and the cutter claw (, around age of 3 yrs old (ICES, 2006; McQuaid *et al.*, 2006) (Portugal L_{50} ~ 28.4 CL)



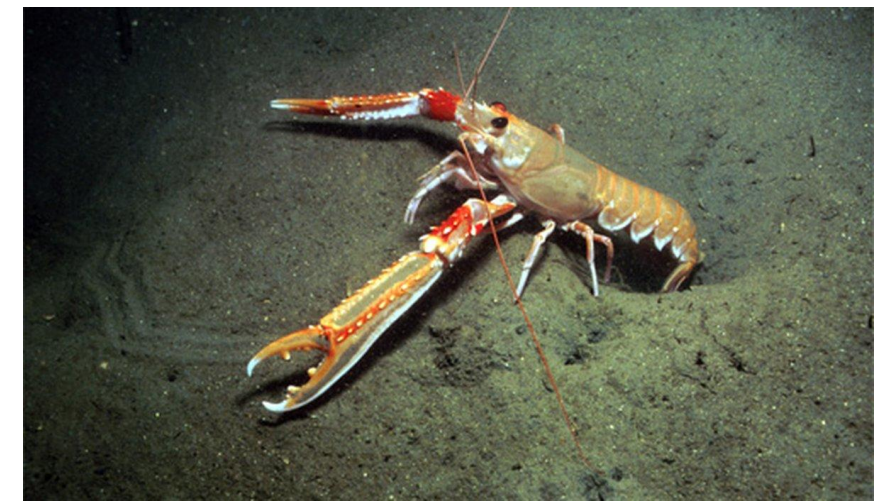
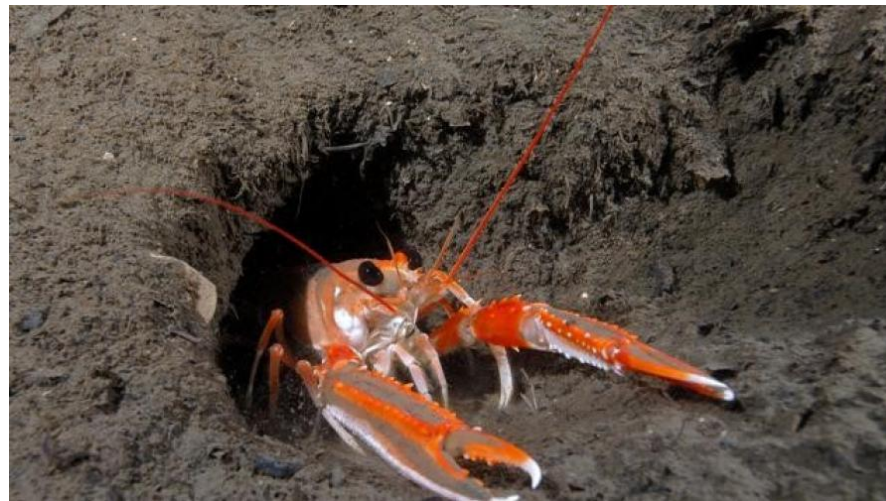
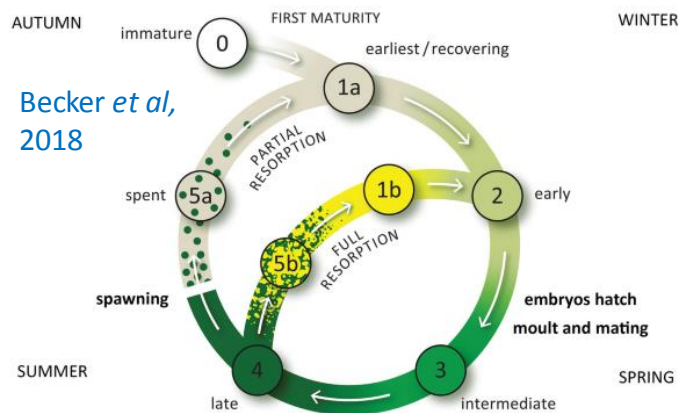


Queirós *et al*, 2013

REPRODUCTION (cont.)

✓ Reproductive cycle

- Mating in winter or spring when females carapace is still soft, after moulting
- Ovaries mature throughout the spring and summer months
- Spawning in late summer-early autumn
- Berried females (egg-bearing females) remain in the burrows until hatching period in late winter-early spring.



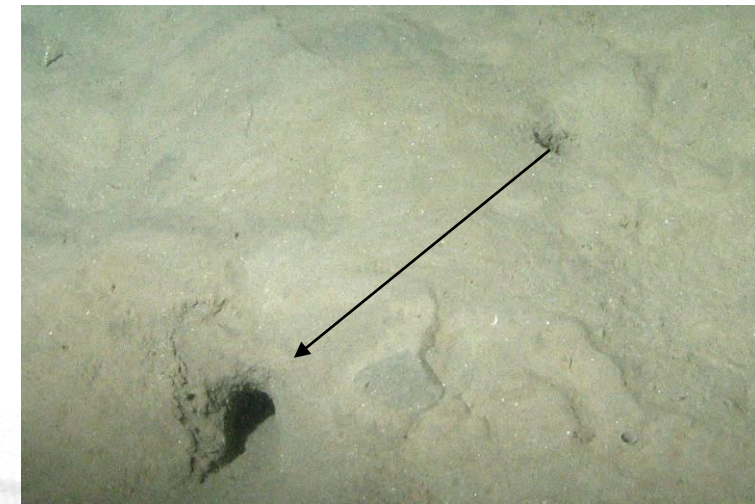


FOOD AND FEEDING

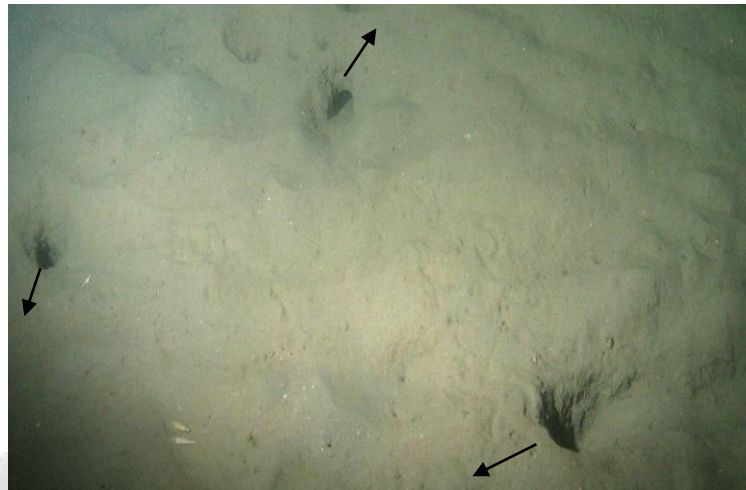
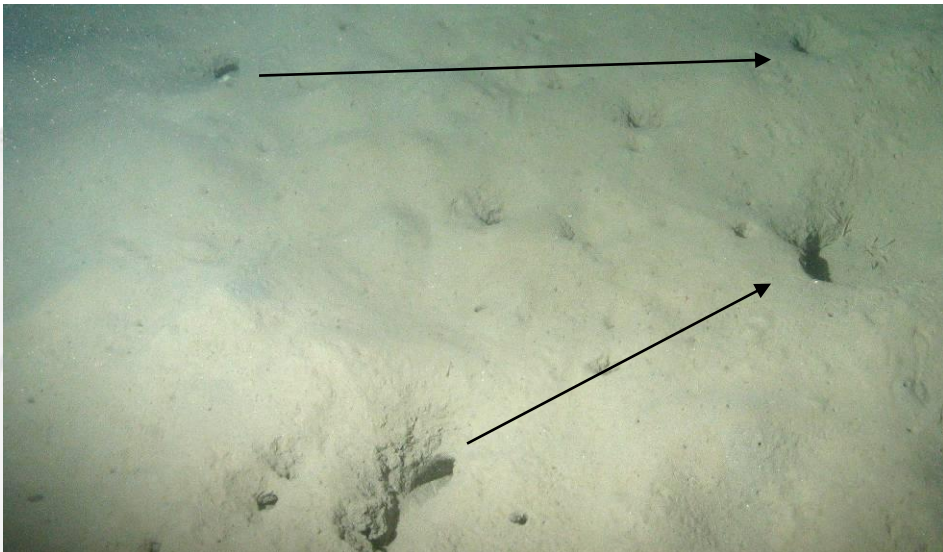
- ✓ Crustaceans, polychaetes, molluscs and, to a lesser extent, echinoderms
- ✓ Cannibalism

ACTIVITY PATTERNS

- ✓ **Burrowing behaviour** – excavate single opening tunnels to multiple opening systems



UWTV surveys aim to estimate absolute biomass by counting the burrows systems





ACTIVITY PATTERNS



- ✓ Spend most of the time inside their burrow or laying at the entrance. Leave the burrows to forage, moulting and for social interactions (as mating). Home behaviour but also shifts from one burrow to the other and fights over the possession of burrows
- ✓ **Diurnal activity pattern** – shallow waters (30 – 40m) emergence peak occurs during night time; intermediate depths (40 – 100m), emergence peaks at dawn and dusk; deeper waters (> 100m) emergence during day-time. **Trawl activity** directed at *Nephrops* is related to this behaviour.
- ✓ **Seasonal activity pattern** – more pronounced in females and are related to the reproductive cycle. After spawning, females stay in the burrows for the entire incubation period (late summer/autumn – late winter/spring). Feeding emergence is not inhibited in ovigerous females. Emergence duration and distance are reduced ('doorkeeping' behaviour) (Aguzzi *et al.*, 2007). **Baited traps or creels** catch more ovigerous females than trawl).



Larval dispersal

- ✓ Planktonic larvae: 3 stages of zoea
- ✓ Post-larval benthic stage move to the seabed
- ✓ Larval development – temperature dependent (3 – 7 weeks)
- ✓ Larval settlement – critical phase in life history, need to settle in areas of suitable sediment to be able to survive
- ✓ Larval transport over long distances raises the possibility of genetic connections between separated stocks

Predators

- ✓ Cod (*Gadus morhua*), pouting (*Trisopterus luscus*), anglerfishes (*Lophius* spp), elasmobranchs, Hake (*Merluccius merluccius*), gurnards (*Trigla* spp) have been reported as *Nephrops* predators.



ICES Functional Units:



- ✓ With UWTV surveys
 - ✓ The absolute biomass is assessed and the harvest rate ($HR = \text{Catch} / \text{Biomass}$) is estimated and compared with the reference HR for the stock. These stocks are considered category 1 stocks and the method provides quantitative assessments and forecasts.
- ✓ No UWTV surveys:
 - ✓ Some are assessed using SPiCT (Surplus Production in Continuous Time), giving the status of the stock and exploitation relative to Reference Points. These stocks have relative reference points and are considered in category 2 stocks. This method also provides forecasts.
 - ✓ Others are assessed using length-based methods and LHI (Life History Invariants) as e.g., Length-Based Indicators (LBI), Mean Length Z and Length-Based Spawning Potential Ratio. These stocks have proxy reference points (mainly for fishing pressure) and the advice is given using the trends from the indices or from these methods.



Muddy sediments

Fishing grounds definition based on VMS data from the Crustacean Fleet

Main *Nephrops* areas (> 200 m):

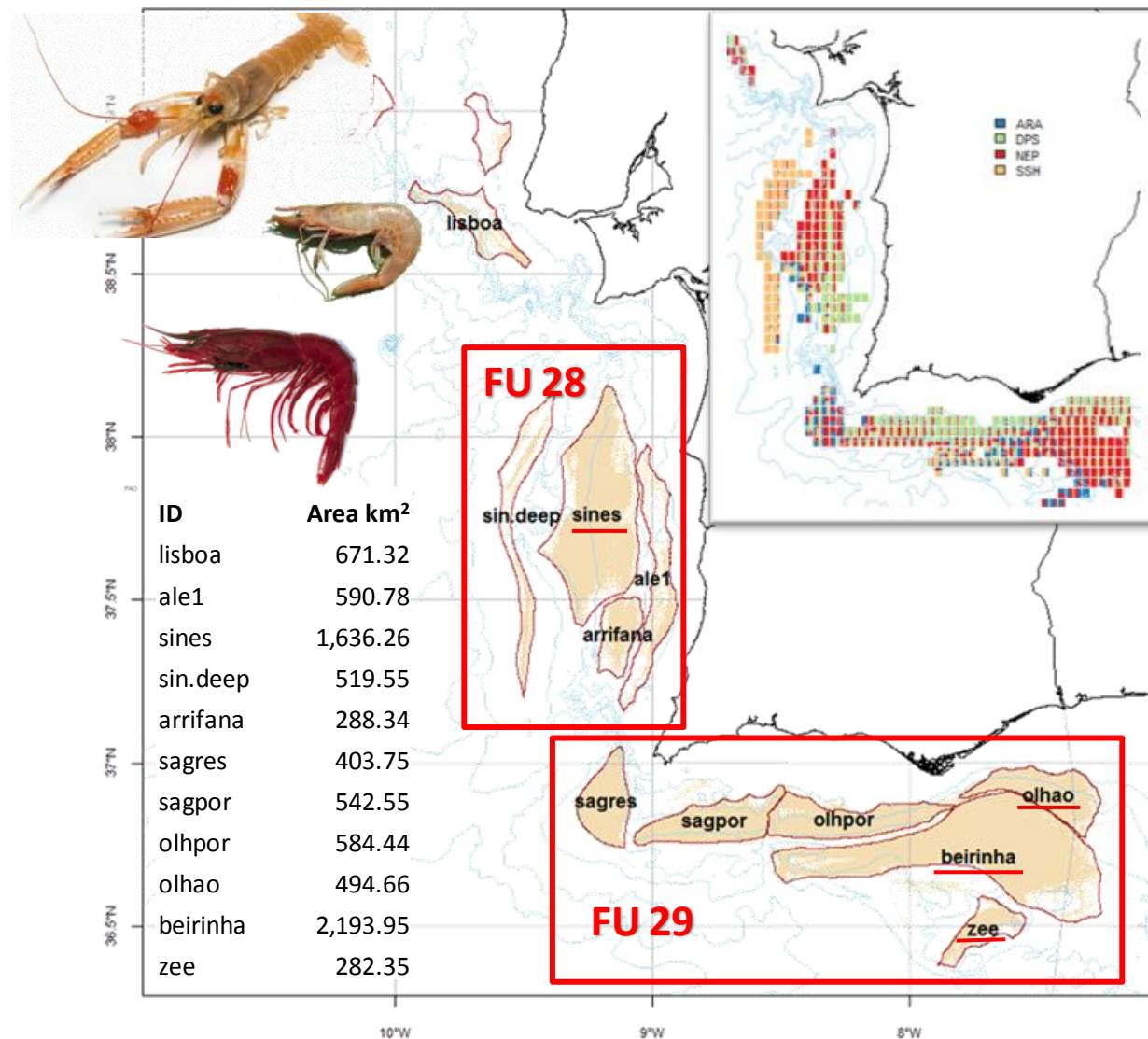
- FU 28: Alentejo (Sines)
- FU 29: Algarve (all areas but mainly Beirinha)

Main *Rose Shrimp* areas (100 – 350 m):

- Alentejo (Arrifana)
- Algarve (Sagres-Portimão, Olhão-Portimão)

Main *Scarlet shrimp* areas (500m – ...):

- Alentejo (Sines deep area > 800m)
- Algarve (very deep areas)



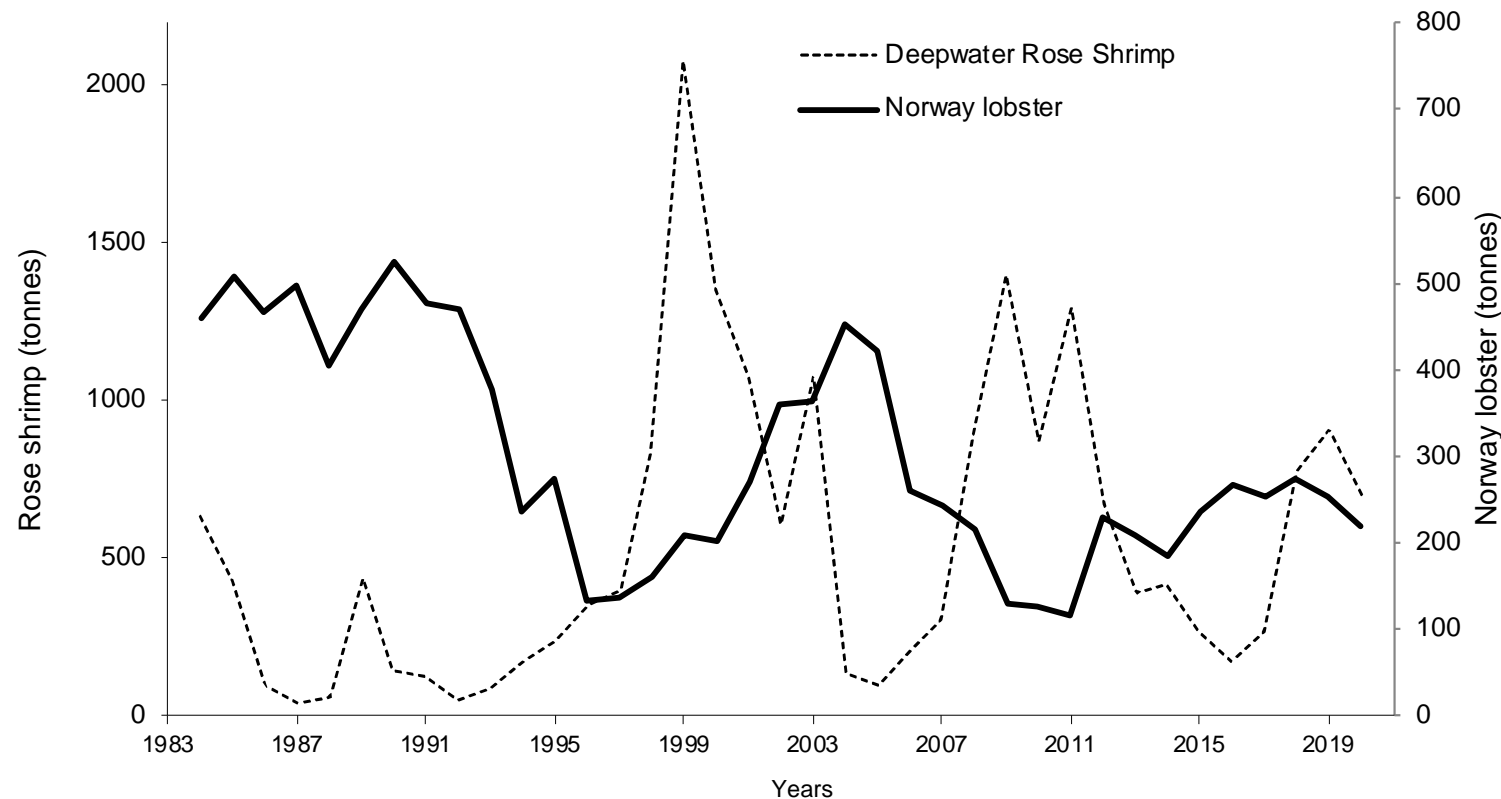


CRUSTACEAN FISHERIES



TRAWL FISHERY

- ✓ 30 vessels
- ✓ Alternate target species: Deepwater rose shrimp (DPS) & Norway lobster (NEP)
- ✓ Different depth ranges although overlapping
- ✓ Seasonal closure of 1 month since 2006 (January); 2 months in 2016 (Jan-Feb)
- ✓ Since 2013, the fleet reduces the activity for *Nephrops* during Sep-Nov, due to quota restrictions





EU Technical Measures

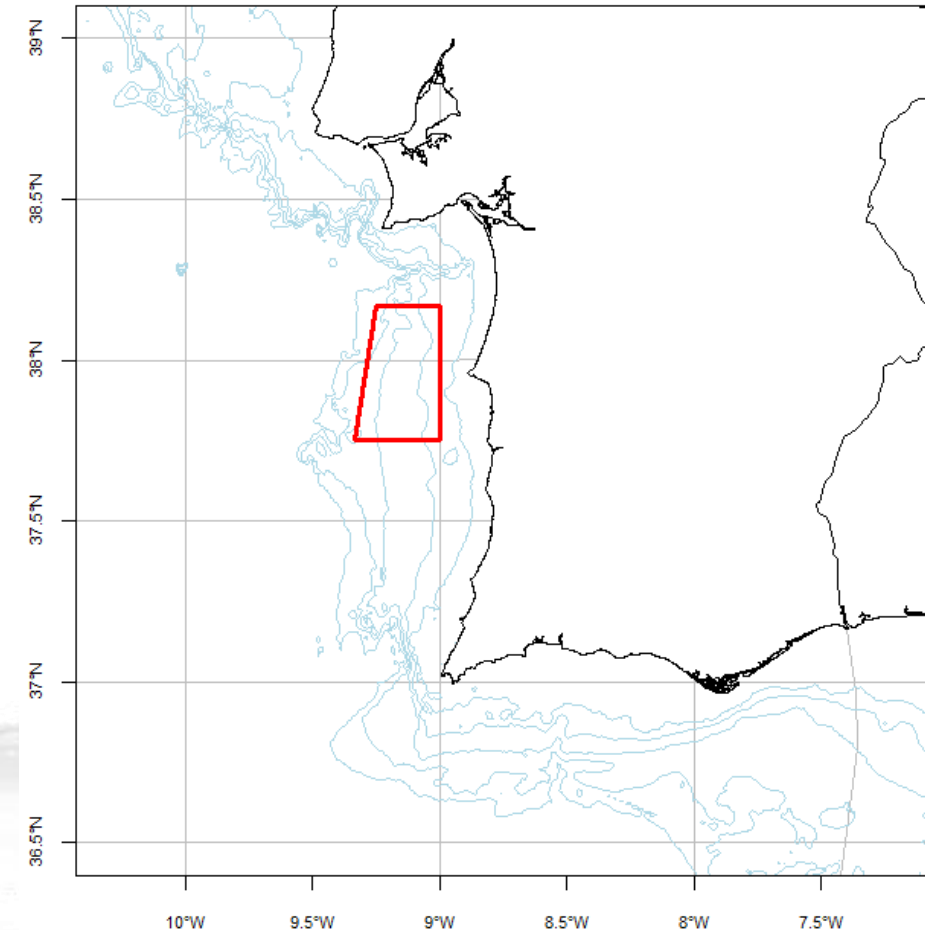
- ✓ Minimum Conservation Size: 20 mm CL, 70 mm TL
- ✓ Minimum mesh size: 55 mm for shrimps, 70 mm for *Nephrops*
- ✓ Box in FU 28 with restrictions for direct fishing in the period May – August, the peak of the fishing season.

EU Catch Regulations

- ✓ TAC for the whole Division 9a, which includes FU 26 (West Galicia), FU 27 (NW Portugal), FU28 (SW Portugal), FU 29 (S Portugal) and FU 30 (Gulf of Cadiz)
- ✓ Multianual Management Plan (MAP) for certain stocks in the Western Waters, including *Nephrops* in FUs 28-29.

National Regulations

- ✓ Closed season for the crustacean fishery in January





Becker,C., Cunningham,E.M., Dick,J.T.A., Eagling,L.E., Sigwart,J.D. 2018. A unified scale for female reproductive stages in the Norway lobster (*Nephrops norvegicus*): Evidence from macroscopic and microscopic characterization. *Journal of Morphology*, 279 (12): 1700-1715.

<https://doi.org/10.1002/jmor.20852>

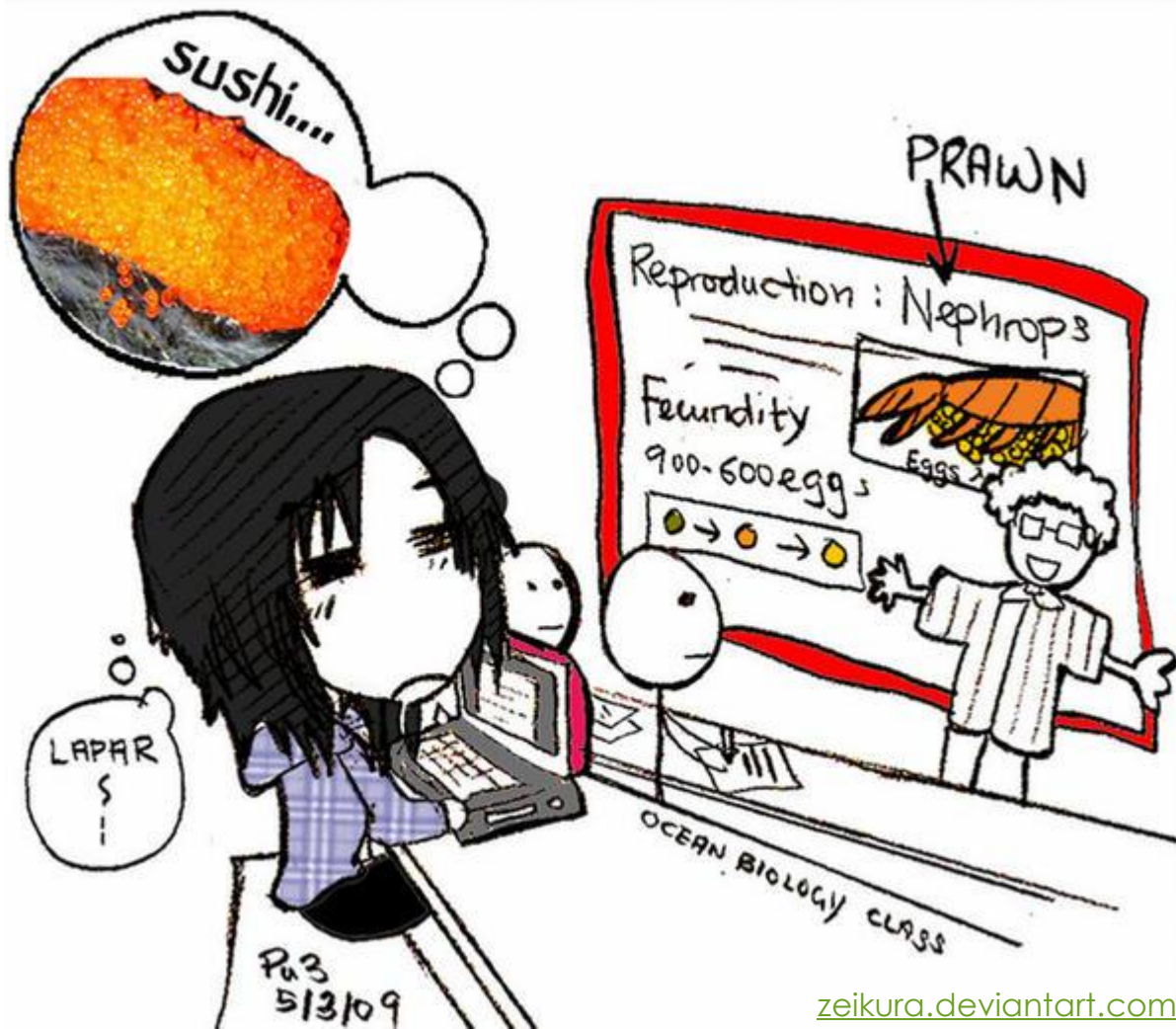
Bell,M.C., Tuck,I., Dobby,H. 2013 *Nephrops* Species. In: Lobsters: Biology, Management, Aquaculture and Fisheries, 2nd ed., 357-413, John Wiley & Sons, Ltd.

ICES. 2006. Report of the Workshop on *Nephrops* Stocks (WKNEPH), 24 – 27 January 2006. ICES CM 2006/ACFM:12, 85 pp.

ICES. 2010. Report of the Workshop on crustaceans (*Aristeus antennatus*, *Aristaeomorpha foliacea*, *Parapenaeus longirostris*, *Nephrops norvegicus*) maturity stages (WKMSC) , 19-23 October 2009, Messina, Italy. ICES CM 2009/ACOM:46. 77 pp.

McQuaid,N., Briggs,R.P., Roberts,D. 2006. Estimation of the size of onset of sexual maturity in *Nephrops norvegicus* (L.). *Fisheries Research*, 81 (1): 26-36. <https://doi.org/10.1016/j.fishres.2006.06.003>

Queirós,A.M., Weetman,A., McLay,H.A., Dobby,H. 2013. Geographical variation in size at the onset of maturity of male and female Norway lobster *Nephrops norvegicus* (L., Homarida: Decapoda) in Scottish waters. *Fisheries Research*, 139 (0): 132-144. <https://doi.org/10.1016/j.fishres.2012.11.002>



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Thank you!