

# PROJECT CEPHS AND CHEFS – OCTOPUS, SQUID, CUTTLEFISH, SUSTAINABLE FISHERIES AND CHEFS

## Brief Summary of achievement, results and highlights

### WP4 (INTEGRATED ECOSYSTEM ASSESSMENT)

#### Action 1

**Genetic barcoding:** This activity provides a summary of the morphological and genetic identification of cephalopod species caught in the North East Atlantic. Cephalopod samples were obtained through a combination of research surveys, port sampling and fish market sampling. Each sample was first examined using morphological characteristics which resulted in 14 species being identified. Tissue samples were also taken from each specimen and DNA barcoding was performed using the COI gene on a total of 1155 individuals. Using barcoding, the number of species identified increased to 30 species, all of which have either been previously recorded in the NE Atlantic waters or their range is expected to extend into these waters. This study revealed which cephalopod species are commonly misidentified on morphological assessment alone, and hence, which are the species that require further development of identification guides to contribute to more accurate fisheries landings data. Processed and unprocessed market products were also barcoded and are presented.

### RESULTS AND HIGHLIGHTS

A report detailing the genetic barcoding and morphological identification of a total of 1155 samples from 30 cephalopod species across the Atlantic Area is available here: <https://www.cephsandchefs.com/wp-content/uploads/2021/05/WP4.1-Barcoding-Report.pdf>

#### Action 2

**Fisheries summaries:** This activity describes key information on four commercially-important species that are also part of the development activities described in WP6 and WP7. The species are: common cuttlefish (*Sepia officinalis*), common Octopus (*Octopus vulgaris*), European northern squid/veined squid (*Loligo forbesii*), and European squid (*Loligo vulgaris*). The information provided includes status and trends for these species, analysis of abundance, fishing mortality, discarding, stock assessment and uncertainties. Data collection and analysis was reviewed within the ICES Working Group of Cephalopod Ecology (WG CEPH).

## RESULTS AND HIGHLIGHTS

A report detailing the stock status, abundance, fisheries landings, discarding, stock assessment and uncertainties in commercially important cephalopods, with an overview of current fisheries management can be found here:

<https://www.cephsandchefs.com/outcomes/work-package-4/>

An annex to the report which includes the results of a common stock assessment approach (Surplus Production in a Continuous Time -SPiCT) is included as Annex 1

A more detailed version of fisheries for *Octopus vulgaris* in the INTERREG Atlantic area is included as Annex 2 to this report.

### Action 3

**Ecosystem assessment:** This activity describes the consequences of changes in the cephalopod compartment on ecosystem models, along with some new information on cephalopod diets. Two existing Ecopath models, English Channel and Moray Firth, were adapted with a different strategy for each: in the Western Channel model (available in the Ecobase repository), the consequences of biomass variation of the cephalopod compartment were tested using a range of variation of the same magnitude as observed in inter-annual trends in squid and cuttlefish abundance. In Scottish waters the Ecopath model developed to analyse the Moray Firth squid fishery was used to simulate increased squid fishing mortality and analyse the impact of squid removal on other groups.

Finally, a preliminary trial to better describe loliginid squid diet was sought with DNA barcoding of stomach contents using specimens collected from commercial fishery landings.

## RESULTS AND HIGHLIGHTS

Changes in cephalopod biomass result in balanced models although biomass reduction seems to have more complex consequences than increased biomass. Simulating increased squid removals by the fishing fleet leads to increases in prey and competitors but also in squid predators. Results from the Moray Firth model will be submitted for publication in an academic journal during the coming months.

Preliminary results of sequencing stomach content DNA show that determination at the species level can help identifying fish prey and can help to distinguish cannibalism and other cephalopod species eaten by squid.

A report presenting the consequences of cephalopod variation at the scale of the ecosystem assessment is available at: <https://www.cephsandchefs.com/outcomes/work-package-4/>

### Action 4

**Review of cephalopod fishing and its environmental impact:** This activity consisted of a review of the effect of fishing gear used for the capture of cephalopods on habitats, on pre-recruit stages, or on other species. This review was mainly focussed on small scale fisheries (SSF) fishing gear as the effects of trawling have been widely described elsewhere. Information about SSF is derived from grey literature. The implications for management and attempts to mitigate impacts were discussed.

## RESULTS AND HIGHLIGHTS

Despite the problems specific to certain fishing gears such as traps which attract mortality from cuttlefish eggs being attached to these fishing devices, fishing gears used by artisanal fleets generally have a lower impact than trawling. The solutions to minimize these impacts often depend on the local context, including the other human activities in a particular area, or on the protections implemented. This review of the environmental effects of cephalopod fishing is available at: <https://www.cephsandchefs.com/outcomes/work-package-4/>

### Action 5

**Integrated ecosystem assessment:** Integrated Ecosystem Assessment (IEA) and Ecosystem-Based Management (EBM) consider stock assessment and fishery management in the context of the status of marine ecosystems and the services provided to society (e.g. an abundant supply of healthy food). This deliverable is in the form of a poster which was presented at the ICES (International Council for Exploration of the Sea) Annual Science Conference 2019. In this poster, we consider requirements, state of the art and future prospects for achieving sustainable cephalopod fishing under an IEA / EBM framework.

## RESULTS AND HIGHLIGHTS

State of the art and ways forward for Integrated Assessment of cephalopods in the Atlantic Area is presented in this poster. It has been disseminated at management-relevant forums (e.g. ICES Annual Science Conference 2019) and it is available at: <https://www.cephsandchefs.com/outcomes/work-package-4/>