# Culture and growth of the jellyfish *Pelagia noctiluca* in the laboratory

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## Summary

Four cohorts of the scyphozoan jellyfish *Pelagia noctiluca* were grown in the laboratory and compared to *in situ* growth observations in the Ligurian Sea from 1969 and 2013. For the first time *P. noctiluca* was grown from eggs through to reproductive adults. The maximum lifespan in laboratory was 17 months. *P. noctiluca* were observed to release gametes at a minimum size of 3 cm bell diameter. Laboratory growth under regular feeding conditions showed initial growth followed by stagnation until dietary conditions were altered.

Maximal growth rates were up to 20% $d^{-1}$ for early stages and 2-5% $d^{-1}$ for adults. Maximal growth rates were comparable between field and laboratory observations.

## Introduction

In the Mediterranean Sea, the Scyphozoan jellyfish *Pelagia noctiluca* has been a recurrent problem for centuries, causing thousands of first aid events annually along the French Riviera (Bernard et al. 2011). These jellyfish have been observed to occur or disappear for several consecutive years, with a periodicity of 10-12 years (Goy et al. 1989, Kogovšek et al. 2010), which have been attributed to climatic forcing. However, since 1994 this species has been present almost continuously in the Ligurian Sea (Bernard et al. 2011, pers. obs.), suggesting a prolonged period of more favourable environmental conditions. *P. noctiluca* is a holoplanktonic species and cannot rely on fixed polyps to survive unfavourable periods.

To understand how *P. noctiluca* can survive during unfavourable periods requires knowledge of their rate of growth, food requirements, and how long they live. However, neither their potential longevity nor growth rates are known for this species and only their ability to survive during short (1-2 month) starvation periods are known (Lilley et al accepted).

We made several attempts to grow *Pelagia noctiluca* in laboratory. From these observations we depict what could be the potential maximal growth rate of this jellyfish, the maximal longevity observed in laboratory and estimate their consumption needs to sustain this growth. Laboratory growth rates were also compared with field observations.

## Materials and Methods

Four different cohorts were grown in the laboratory following the protocol described in Lilley et al (in press). All cohorts were started from fertilized eggs or, in one case, with wild ephyrae. Food was provided regularly mostly in the form of fresh plankton caught by different mesh plankton tows but also using other prey items such as *Artemia salina*, pieces of other types of jellyfish or sea urchin eggs (see Lilley et al in press for full description). All experiments were conducted at 18°C. Individuals were measured regularly and reproduction was recorded when it occurred. On Run 4, size and reproduction observations were continued from day 231 to 490 (Figure 1) using the same food as previously used. Growth rates were calculated using carbon weight, obtained from published *P. noctiluca* diameter (D) to carbon weight (CW) relationship:

$$CW = 0.235\ D^{3.115}$$ (Lilley et al accepted)

For each series of observations, we considered that three or more consecutive observations of increased size corresponded to a positive growth period. For each period, growth rates ($\mu$; $d^{-1}$) were estimated over the whole growth period adjusted using least-squares adjustment on the following equation:

$$W_t = W_0\, e^{\mu t}$$

where $W_0$ is the individual weight at the beginning of each growth period (time t=0 days) and $W_t$ is the weight at the day t.

## Results and Discussion

We described here different attempts to raise *Pelagia noctiluca* from eggs to spawning individuals. Focussing only on Run 4 (Figure 1; see Lilley et al in press for full description of other growth attempts). As previously observed (Lilley et al in press ) after a successful growth period during spring time (d 98 corresponding to 5 July 2013), size stagnated during the summer period and only started to increase again at the end of August (day 152 = 28 August) until late Autumn (day 231; 15 November). The same scheme occurred the following year with successful growth during spring (day 350; 14 March) with size decreasing drastically during July (day 459-490). Those results are certainly an artefact of food quality and quantity provided in the form of a single daily plankton tow that therefore may reflect trophic conditions in the field. Reproduction started at the mean size of 3 cm and was observed at the end of each growth period afterwards. Run 4 experiment encompassed 17 months of survival and is still continuing with 8 individuals still alive.

Mean growth rates observed during successful growth periods (Table 1) started with high growth rates for early stages (0.14-0.2 $d^{-1}$) and decrease to 0.02-0.05 $d^{-1}$ for adult stages.

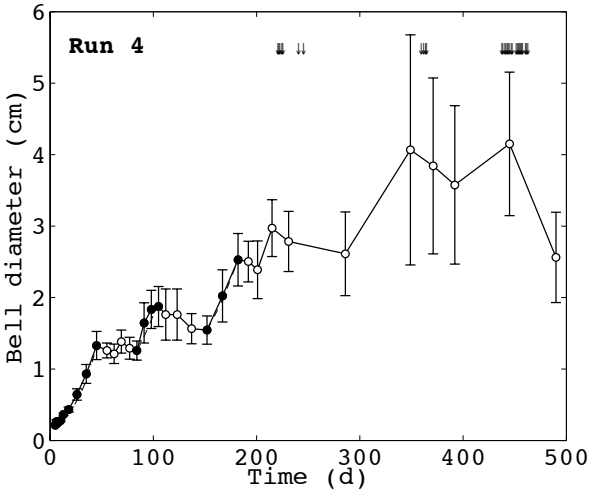


**Figure 1. Growth observations (mean ± SD bell diameter over the lappets) of *Pelagia noctiluca* from the laboratory (Run 4 only). Arrows represent observed spawning events. Filled symbols are sequences of positive growth used in Table 1. Dashed lines (hardly discernable from continuous one) represent the fit of the model estimating the growth rate over the entire period of growth (Table 1).**

**Table 1: Growth rates of laboratory raised populations and in-situ observed ones calculated over positive growth periods (filled symbols, Figure 1). See Lilley et al in press for figures of other observations.**

| *Observation* | *period (d)* | *μ ($d^{-1}$)* | *(±SD)* | *$r^2$* | *n* |
|---|---|---|---|---|---|
| **Run 1** | | | | | |
| period 1 | 51-74 | 0.190 | (±0.013) | 0.95 | 4 |
| period 2 | 76-138 | 0.058 | (±0.001) | 0.99 | 8 |
| period 3 | 231-259 | 0.046 | (±0.005) | 0.96 | 4 |
| period 4 | 293-314 | 0.023 | (±0.014) | 0.87 | 3 |
| **Run 2** | | | | | |
| period 1 | 3-46 | 0.065 | (±0.002) | 0.99 | 7 |
| period 2 | 81-106 | 0.068 | (±0.005) | 0.98 | 5 |
| **Run 4** | | | | | |
| period 1 | 5-45 | 0.143 | (±0.002) | 0.99 | 10 |
| period 2 | 84-105 | 0.065 | (±0.023) | 0.65 | 4 |
| period 3 | 152-182 | 0.051 | (±0.003) | 0.99 | 3 |
| Villefranche 2013 | 70-176 | 0.027 | (±0.001) | 0.99 | 4 |
| Franqueville (1971) | 91-182 | 0.032 | (±0.005) | 0.87 | 4 |

## References

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