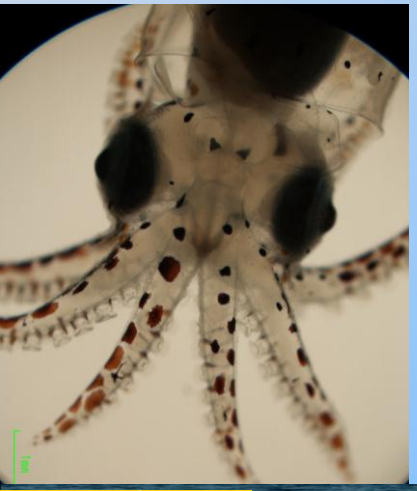
UN OCÉANO, UN FUTURO

1914-2014 CENTENARIO INSTITUTO ESPAÑOL DE OCEANOGRAFÍA

CENTRO OCEANOGRÁFICO DE CANARIAS

# Present knowledge and perspectives in the paralarval culture of *Octopus vulgaris*



**Dr. Eduardo Almansa**

CENTRO OCEANOGRÁFICO DE CANARIAS

INSTITUTO ESPAÑOL DE OCEANOGRAFIA 1914

GOBIERNO DE ESPAÑA

MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD

# BACKGROUND

**The culture of Octopus is hindered by high paralarval mortalities**

**Specific causes remain unidentified**

**Nutritional deficiencies?**

**Only very limited success with crustacean zoeae**

**Previous studies:**

- ✓**Zootechnic**
- ✓**Biochemical analysis**

**The high mortalities still remain**

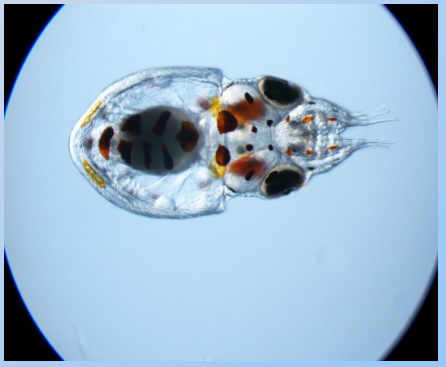
## Multidisciplinary and integrated approach

- Parámetros de calidad
- Condiciones de cultivo
- Alimentación
- Nutrición
- Marcadores de condición
- Calidad de puesta
- Patología y respuesta inmune
- Genómica
- Estrés
- Bienestar animal

# QUALITY PARAMETERS

## Weight/size/nº suckers

- Dry weight
- Size
  - Dorsal
  - Total
- Nº suckers (>3)




Villanueva 1995. CJFAS 52
Okamura et al., 2005. Aqua Sci 53(3)

## Survival (%)

High variability

↕

Unexpected mortalities

No existing system for precise population count

↳

Complex behaviour

- ✓Vertical migration
- ✓Phototactism changes
- ✓Random distribution?

# CONDICIONES DE CULTIVO

Iglesias et al., 2007. Aquaculture 266

**Fotoperiodo:** 14L:10O
**Intensidad:** 500-700 lux

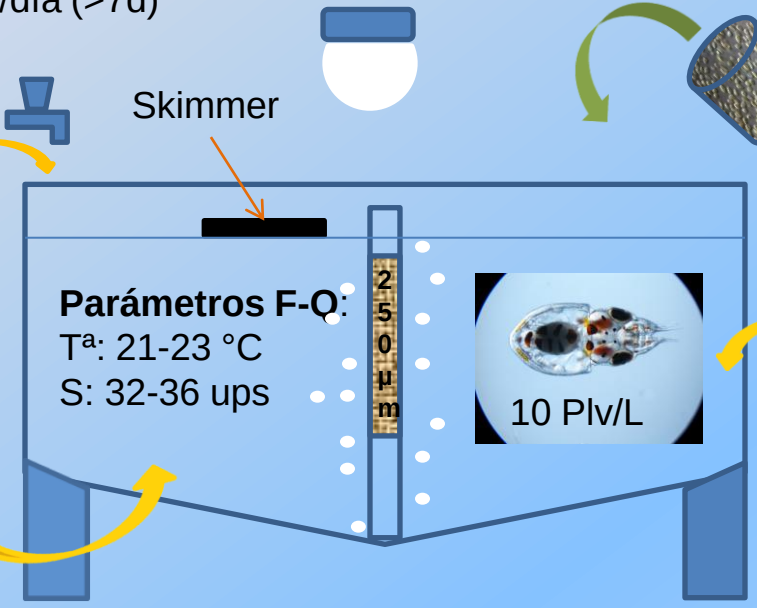
**Renovación:**
4 horas/día (>7d)

**Agua verde:** $1 \cdot 10^6$ cél/mL *Nannochloropsis* sp.

## Artemia

**0-15 días:**
0,5 naupl/mL
*Isochrysis*

**0-30 días:**
0,3 metanpl/mL
(1,5-2 mm)
*Isochrysis* +
*Nannochloropsis*




**Parámetros F-Q:**
Tª: 21-23 °C
S: 32-36 ups

**Tanque**
500-1000 L
Color Negro

**Co-feeding:**
0,05-0,1 zoeas/mL
3-4 veces en semana

**Settlement/move down to the bottom**

Alimentación (mejillón, cangrejo, erizo de mar y misidáceos) / Use of refuges

**Interaction between factors**

# FEEDING AND NUTRITION

## Feeding

Roura et al., 2010. Aqua Res 42(3)

**Wild paralarvae prey**: Decapod crustaceans and euphausiids

**Prey Size:** Preference for larger prey

***Inert diets:*** Few research /numerous factors/great potential

## Lipids

**Rich in colesterol and polyunsaturated fatty acids (PUFA)**
**ω3 (DHA and EPA) and ω6 (ARA)**

Fatty acid metabolism
$C^{14}$ radiotracers

Characterisation of biosynthetic pathways enzymes

Little or no synthesis of PUFA (DHA, EPA , ARA)
+
High content of these fatty acids in Octopus

**DHA, EPA and ARA are essential for Octopus**

# FEEDING AND NUTRITION

## Proteins

Hormiga et al., 2010. JB 149(3)

**Main body component and source of energy:** Optimal prey: 57% dry weight

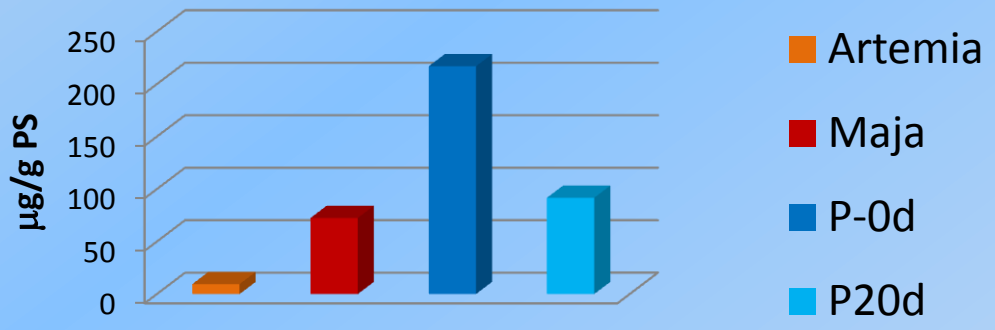
**Aminoacids dissolved in water** Tripled survival rate

Villanueva et al., 2004

**Taurina**: High content in the free aminoacids pool

## Copper

Hemocyanin




## Vitamins

No studies (except for A and E vitamins)

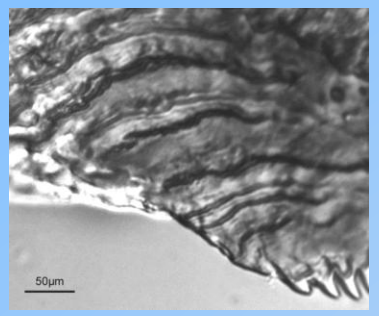
# OTHER ASPECTS

## Biomarkers

- ✓RNA/DNA
- ✓Heat shock Protein (HSP)
- ✓Antioxidant enzymes (ROS)
- ✓Peroxidación lipídica
- ✓Histología
- ✓Enzimas digestivas

## Stress

- ✓Stress hormones Ø
- ✓Stress marks in the beak




## Proteomic

- ✓Nutritional biomarkers (OCTOPHYS)
- ✓Inmune response

## Genomic

International consortium

Albertin et al., 2012. SGS 7

# OTHER ASPECTS

## Calidad de puesta

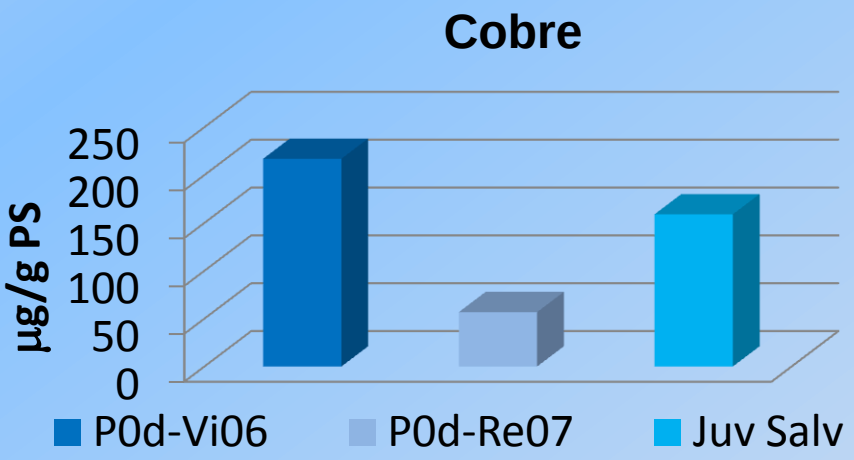
**High variability**

| Hatchlings | Europa | Japón |
|---|---|---|
| Peso seco (mg) | 0,17-0,33 | 0,40 |
| Nº ventosas | 3 | 4 |

**Variability throughout the spawning**:

**Efecto de la madre**

✓Tamaño: >1,5 kg
✓Nutrición: Composición/tamaño
✓Estrés: Adelanta la puesta



# Patología y respuesta inmune

Castellanos-Martínez et al., 2013. JEMBE 447

Albertin et al., 2012. SGS 7

**Inmunidad innata**: No guarda memoria → ~~Vacunación~~

**Expresión de genes inmunes en paralarvas** →
- ✓Alta actividad
- ✓Mayor a partir de 10d

## Genómica

Consorcio internacional

Albertin et al. (2012) Cephalopod Genomics: A Plan of Strategies and Organization. Standards in genomic Sciences, Vol 7 (1)

# Bienestar animal

European Directive 2010/63/EU

Ley 6/2013-España

**COST Action FA1301** "A network for improvement of cephalopod welfare and husbandry in research, aquaculture and fisheries (CephsInAction)"

**3 R**

- **REPLACE**
- **REDUCE**
- **REFINE**

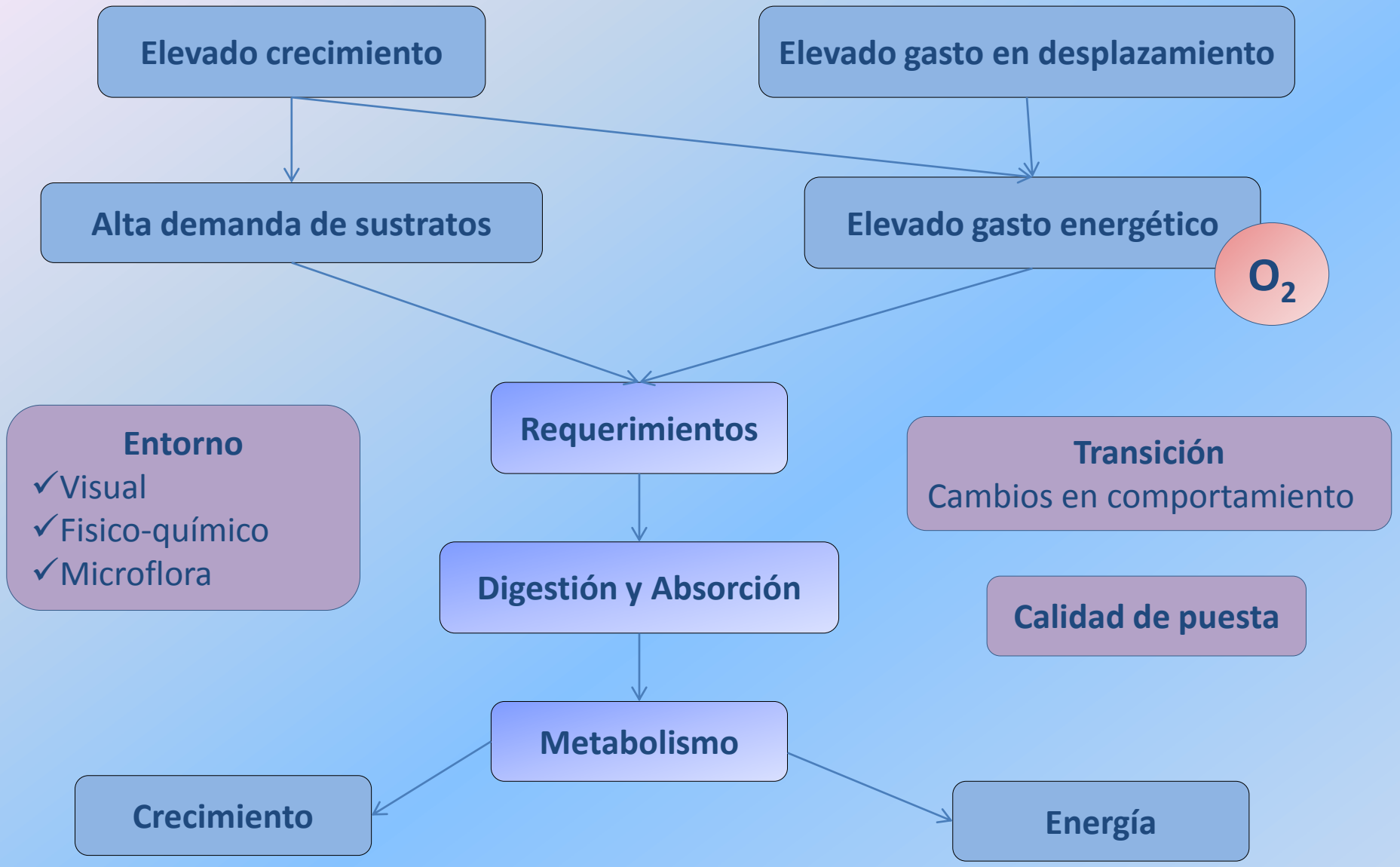
✓Establish cephalopod guidelines
✓Revise current information and produce new information
✓Exchange of information between scholars and institutions

http://www.cephalopodresearch.org/

✓JEMBE Vol. 447. Sep 2013

✓Invertebrate Neuroscience Vol. 13(1), Jun 2013

# CONCLUSIÓN


Elevado crecimiento
Elevado gasto en desplazamiento
Alta demanda de sustratos
Elevado gasto energético
$O_2$
Requerimientos
Entorno
✓Visual
✓Fisico-químico
✓Microflora
Transición
Cambios en comportamiento
Digestión y Absorción
Calidad de puesta
Metabolismo
Crecimiento
Energía

# OCTOPHYS