

**LARVAL DEVELOPMENT OF THE SUBANTARCTIC SQUAT LOBSTER MUNIDA SUBRUGOSA (WHITE, 1847) (ANOMURA: GALATHEIDAE), REARED IN THE LABORATORY**

Patricia Pérez-Barrosa, Sven Thatje, Javier A. Calcagno, Gustavo A. Lovrich-2007

Journal of Experimental Marine Biology and Ecology 352(1): 35-41

**Abstract:**

The larval development of the squat lobster *Munida subrugosa* from subantarctic waters of the Beagle Channel (Tierra del Fuego, Argentina) was studied under controlled laboratory conditions of temperature, salinity, and food supply. Developmental times, survival, and growth of larvae and early juveniles were investigated. Hatching of the entire brood always occurred during one night. Larvae were kept in 100ml individual bowls with filtered seawater at  $8 \pm 0.5^\circ\text{C}$  and fed with *Artemia* spp. nauplii three times a week. Larvae passed through 6 zoeal instars and one megalopa. Previously, only five zoeal instars were known from this species. Mean cumulative durations of the zoeal stages I to VI were:  $20.5 \pm 2.5$ ,  $33.9 \pm 4.1$ ,  $43.3 \pm 5.4$ ,  $52.6 \pm 5$ ,  $61.2 \pm 3.9$ , and 83days, respectively. By adding the 28days that a single megalopa took to metamorphose to crab I stage, the complete larval development lasted 111days. Highest mortality occurred prior to the moult from the zoea I to zoea II stage ( $79.21\% \pm 18.65\%$ ) and during the moult from zoea VI to megalopa ( $92.86\%$ ). Carapace length was  $1.64 \pm 0.06$ ,  $1.52 \pm 0.16$ ,  $1.57 \pm 0.26$ ,  $1.64 \pm 0.21$ ,  $2.11 \pm 0.35$ , and  $2.58 \pm 0.19\text{mm}$ , for zoeal stages I to VI, respectively. Carapace length of megalopae and crab I instars was similar ( $2.85 \pm 0.28$  and the  $2.84 \pm 0.05$ , respectively). Unlike other subantarctic decapods, which show a tendency towards abbreviated larval development and/or some degree of endotrophy, *M. subrugosa* shows an extended planktrophic larval development synchronized with short seasonal plankton production in austral summers.

(Centro Austral de Investigaciones Científicas, Consejo Nacional de Investigaciones Científicas y Técnicas (CADIC - CONICET), CADIC - CC 92, V9410BFD Ushuaia, Tierra del Fuego, Argentina; email of Patricia Pérez-Barrosa: [patopb@yahoo.com](mailto:patopb@yahoo.com))

---

**ONTOGENIC CHANGES IN TOLERANCE TO HYPOXIA AND ENERGY METABOLISM OF LARVAL AND JUVENILE JAPANESE FLOUNDER PARALICHTHYS OLIVACEUS**

Yasunori Ishibashi, Takeshi Kotaki, Yosuke Yamada, Hiromi Ohta-2007

Journal of Experimental Marine Biology and Ecology 352(1): 42-49

**Abstract:**

Changes in tolerances to hypoxia and sodium azide, an indicator of cellular respiration, and activities of various energy metabolism-related chemical components were studied in Japanese flounder *Paralichthys olivaceus* during its early life stages from 3.5 to 20.5 mm in total length (TL). They showed flexion stage around 10.4 mm TL. Lethal levels of hypoxia increased with growth from 3.5 to 8 mm total TL, and the levels remained high in larvae, until 10.4 mm TL, decreased significantly thereafter. The 50% lethal concentration of sodium azide temporarily increased at 4.5 mm TL, diminished drastically between 4.5 and 10.4 mm TL, and then increased again in post-flexion larvae. Cytochrome c oxidase activity was highest in larvae around flexion, at 10.4 mm TL, and subsequently decreased. In post-flexion larvae at 13.0 mm TL, lactate dehydrogenase (LDH) and creatine kinase activities increased; LDH activity decreased at the juvenile stage. The adenosine triphosphate content and energy charge in fish were consistently higher in the larval stage than in the juvenile stage. These results indicated that, from just before flexion to the post-flexion stage, the energy metabolism of larvae is higher due to activated aerobic and subsequent anaerobic metabolism for metamorphosis; as a consequence, hypoxia tolerance in fish is the lowest during the increase of aerobic metabolism just before and around flexion.

(Department of Fisheries, School of Agriculture, Kinki University, Nakamachi, Nara 631-8505, Japan; email of Yasunori Ishibashi: [isibasi@nara.kindai.ac.jp](mailto:isibasi@nara.kindai.ac.jp))

---

FUNGI ISOLATED FROM CULTURED EGGS, ALEVINS AND BROODFISH OF BROWN TROUT IN A HATCHERY AFFECTED BY SAPROLEGNIOSIS

J. M. Fregeneda-Grandes, F. Rodríguez-Cadenas, J. M. Aller-Gancedo-2007

Journal of Fish Biology 71(2): 510-518

Abstract:

The aquatic fungi cultured from eggs, alevins and broodfish of brown trout *Salmo trutta* belonged to the genus *Saprolegnia* and were identified as *S. diclina*, *S. australis*, *S. ferax*, *S. furcata*, *S. hypogyna*, *S. unisporea* and *S. parasitica*. The species obtained from infected eggs and alevins were different to those from infected fish. Several *Saprolegnia* species were isolated from eggs and alevins, whereas all the isolates obtained from broodfish were the pathogenic *S. parasitica*.

(Departamento de Sanidad Animal, Universidad de León, Campus de Vegazana s/n, 24071 León, Spain; email of J. M. Aller-Gancedo: [jmallg@unileon.es](mailto:jmallg@unileon.es))

---

THE EFFECTS OF ENVIRONMENTAL FACTORS ON RAINBOW SMELT *OSMERUS MORDAX* EMBRYOS AND LARVAE

K. M. Fuda, B. M. Smith, M. P. Lesser, B. J. Legare, H. R. Breig, R. B. Stack, D. L. Berlinsky-2007

Journal of Fish Biology 71 (2): 539–549

Abstract:

Experiments were conducted to identify environmental factors that influence the survival of rainbow smelt *Osmerus mordax* during their early life stages. Developing rainbow smelt embryos and yolk-sac larvae were cultured under controlled conditions with different dissolved oxygen (DO; 1.09, 2.18, 4.37 and 6.55 mg l<sup>-1</sup>, pH (4.0, 4.5, 5.0, 5.5, 6.0 and 7.0), nitrate (0.7, 3.6, 7.3, 14.6 and 29.2 mg l<sup>-1</sup>), phosphate (0.04, 0.21, 0.42, 2.08 and 4.17 mg l<sup>-1</sup>) and salinity (0, 5, 10, 15, 20 and 30) levels. Rainbow smelt embryos were also incubated with simulated tidal salinity fluctuations (2–28), ultraviolet radiation (irradiances of 2.8, 6.2 and 5.1 W m<sup>-2</sup>) and under natural conditions in two rainbow smelt spawning rivers. In the laboratory, hatch was only impaired under the lowest DO and pH conditions (0 and 13% hatch, respectively) and at highest constant salinity levels (0% hatch). Larval survival was only affected by pH levels ≤5.0. The experiment that compared hatch under natural conditions was terminated when embryos became covered with silt and fungus. These results suggest that water acidification, sediment and fungal growth may affect rainbow smelt survival during their early life stages.

(Department of Zoology, University of New Hampshire, Durham, NH 03824, U.S.A.; email of D. L. Berlinsky: [david.berlinsky@unh.edu](mailto:david.berlinsky@unh.edu))

---

EFFECT OF LIGHT INTENSITY AND EYE DEVELOPMENT ON PREY CAPTURE BY LARVAL STRIPED BASS *MORONE SAXATILIS*

K. E. MacIntosh, J. Duston-2007

Journal of Fish Biology 71 (3): 725–736.

Abstract:

The efficacy of visual and non-visual feeding among pelagic striped bass *Morone saxatilis* larvae adapted to a turbid estuary was determined in the laboratory in clear water. Capture of *Artemia salina* (density 100 l<sup>-1</sup>) was significantly affected by the interaction between age of larvae (range: 8–25 days post-hatch, dph) and light intensity (range: 0–10.6 μmol s<sup>-1</sup> m<sup>-2</sup> at the water surface). Visual feeding by larvae aged 9–11 dph was highest in dim light (0.086–0.79 μmol s<sup>-1</sup> m<sup>-2</sup>), with fish capturing up to 5 prey larval h<sup>-1</sup>. As the larvae grew, prey capture in

brighter light improved, associated with an increasing proportion of twin cone photoreceptors and improving ability of the retina to light- and dark-adapt. By age >22 dph, mean prey capture was greatest at highest light intensities (0.79 and 10.6  $\mu\text{mol s}^{-1} \text{m}^{-2}$ ) exceeding 100 prey larva<sup>-1</sup> h<sup>-1</sup>. Incidence of feeding larvae generally improved as the larvae grew, reaching >80% in all light intensities from 16 dph onwards. The lower threshold for visual feeding, between 0.0084 and 0.03  $\mu\text{mol s}^{-1} \text{m}^{-2}$ , remained constant as the larvae grew, despite an increasing density of rod photoreceptors. Below this threshold, non-visual feeding was evident at a low rate (<6 prey larva<sup>-1</sup> h<sup>-1</sup>) that was independent of larval age.

(Department of Biology, Cape Breton University, 1250 Grand Lake Road, Sydney, N.S. B1P 6L2, Canada; email of J. Duston: [jduston@nsac.ca](mailto:jduston@nsac.ca))

---

EFFECTS OF LIGHT INTENSITY AND ADDITION OF CAROTENE RICH DUNALIELLA SALINA LIVE CELLS ON GROWTH AND ANTIOXIDANT ACTIVITY OF SOLEA SENEGALENSIS KAUP (1858) LARVAL AND METAMORPHIC STAGES

J. P. Cañavate, A. Prieto, R. Zerolo, M. Sole, C. Sarasquete, C. Fernández-Díaz-2007

Journal of Fish Biology 71 (3): 781–794

Abstract:

Senegal sole *Solea senegalensis* larval and metamorphic stages were exposed to a range of light intensities (200, 1000 and 2000 lx) in cultures with or without supplementation of  $\beta$ -carotene-rich live *Dunaliella salina* cells. Antioxidant biomarkers such as superoxide dismutase (SOD), catalase (KAT), total glutathione peroxidase (t-GPX) and malondialdehyde (MDA) were determined in larval and metamorphic stages. Growth was not affected ( $P > 0.05$ ) either by light intensity or *D. salina* supplementation. Survival after metamorphosis was also unaffected by *D. salina* supplementation (mean  $\pm$  s.e.  $81.0 \pm 2.5\%$  against  $80.6 \pm 2.9\%$  those fed the control algal diet) or light intensity (mean  $\pm$  s.e.  $74.3 \pm 4.9\%$  for 200 lx,  $85.1 \pm 2.7\%$  for 1000 lx and  $82.8 \pm 5.2\%$  for 2000 lx, respectively). Light intensity affected ( $P < 0.05$ ) KAT and t-GPX throughout development. SOD was only affected in metamorphosing larvae. The highest KAT and t-GPX activities were detected when the lowest light intensity (200 lx) was used. Light had no effect ( $P > 0.05$ ) on MDA at any stage. Supplementing the diet with *D. salina* did not affect SOD, KAT or t-GPX and there was no interaction ( $P > 0.05$ ) with light intensity. MDA was the only biomarker whose activity was significantly ( $P < 0.05$ ) reduced when *D. salina* was supplemented to the larval rearing tanks. The effect of *D. salina* supplementation was only detected in metamorphosing larvae, whose MDA levels were noticeably higher than in earlier stages. These results are evidence of the antiperoxidative effect of  $\beta$ -carotene from live algae in the larval rearing process of marine fishes.

(CIFAP "El Toruño", IFAPA, Junta de Andalucía, Apartado 16, 11500 Puerto de Santa María, Cádiz, Spain; email of J. P. Cañavate: [josep.canavate@juntadeandalucia.es](mailto:josep.canavate@juntadeandalucia.es))

---

AUTOTRIPLOID TENCH TINCA TINCA (L.) LARVAE OBTAINED BY FERTILIZATION OF EGGS PREVIOUSLY SUBJECTED TO POSTOVULATORY AGEING IN VITRO AND IN VIVO

M. Flajšhans, K. Kohlmann, P. Ráb-2007

Journal of Fish Biology 71 (3): 868–876.

Abstract:

Eggs of diploid tench *Tinca tinca* were half-stripped out and stored for 0 (control batch), 1, 3 and 5 h at mean  $\pm$  s.d.  $17.0 \pm 0.4$  and  $21.9 \pm 0.5^\circ \text{C}$  or for 0, 1, 2, 3, 4 and 5 h at  $24.0 \pm 0.0^\circ \text{C}$  in vitro prior to fertilization. The eggs remaining in vivo in the fish kept at  $17.0 \pm 0.4$  and  $21.9 \pm 0.5^\circ \text{C}$  were collected and fertilized in the same time intervals. Fertilization rate and larval yield mostly decreased after 3–5 h storage of eggs both in vitro and in vivo and only the diploid larvae were found in all control batches. Triploid larval yields increased to a maximum 5.26% after 5 h in vitro storage at  $24.0^\circ \text{C}$  and 1.07 and 1.60% after 3 h in vitro storage at  $21.9$  and  $17.0^\circ \text{C}$ , respectively. Triploid larval yield during in vivo storage at  $21.9^\circ$

C reached a maximum 0.91% after 5 h. As the spontaneous autotriploid larvae arose solely from fertilized eggs previously subjected to postovulatory egg ageing by means of prolonged storage, the autotriploidy was probably caused by failure of extrusion of the second polar body.

(University of South Bohemia České Budějovice, Research Institute of Fish Culture and Hydrobiology, 389 25 Vodňany, Czech Republic; email of M. Flajšhans: [flajshans@vurh.jcu.cz](mailto:flajshans@vurh.jcu.cz))

---

#### IDENTIFICATION OF FISH SPECIES BY AN EGG IDENTIFICATION KEY: AN ALTERNATIVE TO THE INCUBATION OF EGGS AND REARING OF LARVAE FOR SPECIES RECOGNITION

J. Simon-2007

Journal of Fish Biology 71 (4): 1241–1248.

Abstract:

Comparison of the results of two methods for species recognition, an egg identification key and rearing of larvae, showed only small qualitative differences in the identification of fish species present in a stretch of the River Elbe, Germany. Both the identification key and rearing methods complement each other as methods of identification, and the selection of which method to be used should depend primarily on the aim of the investigation.

(Institute for Inland Fisheries e.V. Potsdam-Sacrow, Im Königswald 2, D-14469 Potsdam, Germany; [j.simon@startplus.de](mailto:j.simon@startplus.de))

---

#### EMBRYOLOGY AND EARLY ONTOGENY OF AN ANEMONEFISH AMPHIPRION OCELLARIS

Inayah Yasir, Jian G. Qin-2007

Journal of the Marine Biological Association of the UK 87: 1025-1033

Abstract:

The present study describes the embryonic development and early ontogeny of Amphiprion ocellaris from fertilization to post hatching. Anemonefish spontaneously spawned at 27–28°C. The newly laid eggs were orange in colour and elliptical in shape (1.8×0.8 mm). Melanin appeared as a black mass situated at the vegetal pole in mature eggs. This is rarely seen in eggs of other fish species. We documented developmental times at 27–28°C to egg activation (0.5 h), cleavage (4 h), blastula (11.5 h), gastrula (20 h), neurula (24.5 h), somite (28.5 h), turnover (72 h), blood formation (113 h) and internal ear and jaw formation (144 h). Hatching occurred 152 h after fertilization. On day 4, the eye buds were pigmented and melanophores formed on the ventral surface of the embryo. Internal ear and gill formation were completed on day 5 and coincided with movement of the opercula and pectoral fins. The mouth formed on day 6 and the digestive tract appeared on day 7. By day 10, the yolk was fully absorbed and a substantial amount of food was observed in the gut. Dark and orange pigments were dispersed and aggregated through muscle contractions by day 14, but red pigments did not appear until the fish were three months old. This study contributes to a further understanding of the embryology and the early ontogeny of damselfish and may help improve the culture of coral reef fish.

(School of Biological Sciences, Flinders University, GPO Box 2100, 5001 SA Adelaide, Australia; email of Jian G. Qin: [Jian.Qin@Flinders.edu.au](mailto:Jian.Qin@Flinders.edu.au))

---

#### THE USE OF BLACK FLY LARVAE AS A FOOD SOURCE FOR HATCHERY-REARED LAKE STURGEON

Cheryl N. Klassen, Stephan J. Peake-2007

North American Journal of Aquaculture 69(3): 223–228

Abstract:

---

Live and frozen black fly larvae (Diptera: Simuliidae) were incorporated into the diets of larval lake sturgeon *Acipenser fulvescens* in 2002 and 2005 for a 6-week period to determine whether fish would accept this invertebrate diet more readily than conventional bloodworm (Diptera: Chironomidae) diets. In 2002, daily feedings of live black fly larvae within an 8-h period resulted in a mean survival rate of 37%. Adjusting the diet regime in 2005 (i.e., initial diet of brine shrimp *Artemia* spp., two daily feedings within a 14-h period, and diet transition periods of 3, 5, and 7 d) resulted in overall mean survival rates greater than 80%. Survival of lake sturgeon transitioned to black fly larvae was significantly better than that of control groups transitioned to bloodworms over 3 d and statistically similar to that of bloodworm-fed groups transitioned over 5 and 7 d. Fewer feedings and lower daily rations of black fly larvae in comparison with bloodworms did not result in differences between the final mean mass of fish in 2005. We conclude that frozen black fly larvae can reduce the effort required to transition lake sturgeon from an initial diet of brine shrimp without compromising current survival and growth standards achieved with bloodworm diets.

(Canadian Rivers Institute and Department of Biology, University of New Brunswick, Post Office Box 45111, Fredericton, New Brunswick E3B 6E1, Canada)

---

## REVIEW

### URMIA LAKE (NORTHWEST IRAN): A BRIEF REVIEW

Amin Eimanifar, Feridon Mohebbi-2007

#### Abstract:

Lake Urmia (or Ormiyeh) is one of the largest hypersaline lakes in the world and the habitat of a unique bisexual *Artemia* species (*A. urmiana*). Despite this, and several other values of the lake, little literature on it has been published. The present paper is an attempt to provide a brief review on various aspects of the lake. Urmia Lake, located in northwestern Iran, is an oligotrophic lake of thalassohaline origin with a total surface area between 4750 and 6100 km<sup>2</sup> and a maximum depth of 16 m at an altitude of 1250 m. The lake is divided into north and south parts separated by a causeway in which a 1500-m gap provides little exchange of water between the two parts. Due to drought and increased demands for agricultural water in the lake's basin, the salinity of the lake has risen to more than 300 g/L during recent years, and large areas of the lake bed have been desiccated. Therefore, management and conservation of this incomparable ecosystem should be considered to improve the current condition by fisheries research institutes.

(Iranian *Artemia* Research Center, P.O. Box: 57135-1367, Urmia, Iran)

---