

Final project report

<i>Project ID</i>	2004/8.04
<i>Title</i>	Ecology and life cycle of Southern Ocean fish species
<i>Principal investigator</i>	Marino Vacchi
<i>Institution</i>	ISPRA c/o MNA – University of Genoa, Italy
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<i>Duration</i>	3 years
<i>Assigned funding</i>	130.000,00 Euro

Activities and results

The discovery of spawning sites of *Pleuragramma antarcticum* at Terra Nova Bay (TNB), Ross Sea revealed that eggs and larvae of this important fish species occur under the sea-ice, trapped in the platelet ice layer, in springtime. Therefore in 2005 and 2006, extensive surveys were performed at TNB by drilling the sea-ice, to evaluate the extent of the nursery and to investigate the linkage between the early life stages of the fish and the seasonal ice. *P. antarcticum* eggs and young larvae were concentrated in an area of 200 km², surrounding the coastal tongue of Campbell Glacier where most of the samples had more than 100 eggs per litre of sea water. The distribution of the samples overlap the area of presence of platelet ice, thus indicating that the platelet ice layer has become a crucial habitat for the reproductive cycle of *P. antarcticum*, in that region. Field activity at TNB was also performed during the summer months in ice-free waters in order to improve the knowledge of distribution and local abundance of larval stages of *P. antarcticum*. In the frame of the collaborative international exchanges, NZ and US partners in the project participated in the field activity at MZS to investigate the physio-ecology of eggs and embryos of *Pleuragramma antarcticum* and elucidate their antifreeze characteristics in the very early steps of its life cycle.

Through histological and molecular analyses pre- and post-hatching stages of *P. antarcticum* were characterized for the first time in order to understand the possible influence of the seasonal sea ice on the pattern of early development and life cycle.

By using Romeo, a ROV designed for mid water marine science applications, with high horizontal manoeuvrability and precision altitude control, a survey focused on fish was carried out at MZS in October-November 2005 when the coastal region is completely covered by the pack ice. Nine species from 4 notothenioid families were recorded in their habitat as video clips. Among the most interesting features, large shallow schooling of *Trematomus newnesi*, nesting and parental care of *Pagetopsis macropterus*, digging of *Chionodraco hamatus* and predation of *Histiodraco velifer* were recorded in situ for the first time. In the context of fishery management studies the project included the participation in Antarctic Research cruises of foreign vessels such as Polarstern, Yuzhmorgeologiya and Tangaroa. The sampling allowed to collect important data on biological and ecological aspects related to the Antarctic fish stocks characterization and food webs such as age and growth, reproduction and feeding.

Products

A – papers in scientific magazines

1. Albertson R. C., Yan Y.-L., Titus T. A., Pisano E., Vacchi M., Yelick P. C., Detrich H. W., Postlethwait J. H., 2010. Molecular pedomorphism underlies branchiocranial skeletal evolution in Antarctic notothenioid fishes. *BMC Evolutionary Biology*, 10:4.
2. La Mesa M., Catalano B., Russo A., Greco S., Vacchi M., Azzali M., 2010. Influence of environmental conditions on spatial distribution and abundance of early life stages of Antarctic silverfish, *Pleuragramma antarcticum* (Nototheniidae), in the Ross Sea. *Antarctic Science* (doi:10.1017/S0954102009990721).
3. Ashford J., M. La Mesa, B. Fach, C. Jones 2010. Testing early life connectivity in Scotia Sea icefish using otolith chemistry and particle tracking simulations. *Canadian Journal of Fisheries and Aquatic Science*, in press.

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4. Bottaro M., Oliveri D., Ghigliotti L., Pisano E., Ferrando S., Vacchi M., 2009. Born among the ice: first morphological observations on two developmental stages of the Antarctic silverfish *Pleuragramma antarcticum*, a key species of the Southern Ocean. *Rev Fish Biol Fisheries*, 19:249–259.
5. Bottaro M., Ferrando S., Ravera S., Vacchi M., Gallus L., Gambardella C., Tagliaferro G., 2009. First detection of neuropeptide Y (NPY)-like immunoreactivity in the lateral line: Presence and distribution in the neuromasts of the Antarctic notothenioid fish *Trematomus bernacchii*. *Neuroscience Letters*, 458(1): 37-42.
6. Granata A., Zagami G., Vacchi M., Guglielmo L., 2009. Summer and spring trophic niche of larval and juvenile *Pleuragramma antarcticum* in the Western Ross Sea, Antarctica. *Polar Biol*, 32: 369–382
7. La Mesa M., A. De Felice, C.D. Jones, K.-H. Kock 2009. Age and growth of spiny icefish, *Chaenodraco wilsoni* Regan, 1914, off Joinville-D'Urville Islands (Antarctic Peninsula). *CCAMLR Science*, 16: 115-130.
8. Koubbi P., Duhamel G., Hecq J.-H., Beans C., Loots C., Pruvost P., Tavernier E., Vacchi M., Vallet C., 2009. Ichthyoplankton in the neritic and coastal zone of Antarctica and Subantarctic islands: A review. *Journal of Marine Systems*, 78(4): 547-556
9. Jones C.D., Anderson M. E., Balushkin A.V., Duhamel G., Eakin R.R., Eastman J.T., Kuhn K.L., Lecointre G., Near T.J., North A.W., Stein D.L., Vacchi M., • Detrich III H. W., 2008. Diversity, relative abundance, new locality records and population structure of Antarctic demersal fishes from the northern Scotia Arc islands and Bouvetøya. *Polar Biol*, 31: 1481-1497
10. La Mesa M., J. Ashford 2008. Age and early life history of juvenile Scotia Sea icefish, *Chaenocephalus aceratus*, from Elephant and the South Shetland islands. *Polar Biol*, 31 (2): 221-228.
11. La Mesa M., J. Ashford 2008. Age and growth of ocellated icefish, *Chionodraco rastrospinosus* (DeWitt and Hureau, 1979), from the South Shetland Islands. *Polar Biol*, 31 (11): 1333-1342.
12. Vacchi M., Bottaro M., Pisano E., Eastman J.T., Eakin R.R., 2007. Aspects of gonadal morphology in the South Georgian plunderfish *Artedidraco mirus* (Perciformes: Artedidraconidae). *Polar Biol*, 30: 125-131. IF=1.734
13. Koubbi P., Vallet C., Razouls S., Grioche A., Hilde D., Courcot L., Janquin M.A., Vacchi M., Hureau J.-C., 2007. Condition and diet of larval *Pleuragramma antarcticum* (Nototheniidae) from Terre Adélie (Antarctica) during summer. *Cybium*, 31(1): 67-76
14. La Mesa M., 2007. The utility of otolith microstructure in determining the timing and position of the first annulus in juvenile Antarctic toothfish (*Dissostichus mawsoni*) from the South Shetland Islands. *Polar Biol*, 30(10): 1219-1226.
15. Papetti C., E. Susana, M. La Mesa, T. Patarnello, L. Zane 2007. Microsatellite analysis reveals genetic differentiation between year-classes in the icefish *Chaenocephalus aceratus* at South Shetlands and Elephant Island. *Polar Biol*, 30(12): 1605-1613.
16. Lauriano G., Vacchi M., Ainley D., Ballard G., 2007. Observations of top predators foraging on fish in the pack ice of the southern Ross Sea. *Antarctic Science*, 19(4): 439-440.
17. Dalla Riva S., Abemoschi M. L., Grotti M., Soggia F., Bottaro M., Vacchi M., 2006. The occurrence of lead in the bone tissues of *Trematomus bernacchii* (Terra Nova Bay, Ross Sea, Antarctica). *Antarctic Science*, 18(1): 75-80
18. La Mesa M., Cattaneo-Vietti R., Vacchi M., 2006. Species composition and distribution of the Antarctic plunderfishes (Pisces, Artedidraconidae) from the Ross Sea off Victoria Land. *Deep-Sea Research II*, 53: 1061-1070
19. Eakin R.R., Eastman J.T., Vacchi M., 2006. Sexual dimorphism and mental barbel structure in the South Georgian plunderfish *Artedidraco mirus* (Perciformes: Notothenioidae: Artedidraconidae). *Polar Biol*, 30: 45-52
20. La Mesa M., Vacchi M., 2005. On the second record of the Antarctic plunderfish *Artedidraco glareobarbatus* (Artedidraconidae) from the Ross Sea. *Polar Biol*, 29(1): 40-43
21. Detrich H. W., Jones C. D., Kim S., North A. W., Thurber A., Vacchi M., 2005. Nesting behavior of the icefish *Chaenocephalus aceratus* at Bouvetøya Island, Southern Ocean. *Polar Biol*, 28(11): 828-832
22. La Mesa M., J. Ashford, E. Larson, M. Vacchi, 2004. Age and growth of Scotia Sea icefish, *Chaenocephalus aceratus*, from the South Shetland Islands. *Antarctic Science*, 16 (3): 253-262.
23. Vacchi M., M. La Mesa, M. Dalù, J. MacDonald, 2004. Early life stages of the Antarctic silverfish, *Pleuragramma antarcticum* Boulenger, 1902 in Terra Nova Bay (Ross Sea, Antarctica). *Antarctic Science*, 16 (3): 299-305.

B – book chapters

1. v. Busekist, J., Vacchi, M., Albertelli, G., 2007. "ANFIBO Base", a computer-based system for identification of fish bones from Antarctic waters. Version 1.0 for MS-Windows CD-ROM. <http://www.mna.it>, University of Genoa, Italy.

C - proceedings of international conferences

1. Ghigliotti L., Near T. J., Vacchi M., Pisano E. 2009 Lights On The Karyotypic Evolution Within The Teleostean Family Artedidraconidae 70 Congresso UZI, Rapallo (GE) Abstracts: 140
2. Pisano E., Ghigliotti L., Bono R., Spirandelli E., BottaRo M., Vacchi M. 2008 Fish life under the Antarctic ice. XXX SCAR Open Science Conference, St. Petersburg, Abstracts: 464.
3. Bottaro M., Vannini G., Pisano E., Bono R., Vacchi M. 2008. The coastal fish assemblages at terra Nova Bay in sea-ice and open water conditions XXX SCAR Open Science Conference, St. Petersburg, Abstracts: 302.
4. La Mesa M., A. De Felice, C.D. Jones, K.H. Kock 2008. Age and growth of spiny icefish, *Chaenodraco wilsoni* Regan, 1914, off Joinville-D'Urville Islands (Antarctic Peninsula). WG-FSA-08/00, Working Group "Fish Stock

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- Assessment" CCAMLR, 20 pp. October 2008, Hobart, Tasmania, Australia.
5. v. Busekist, J., Vacchi, M., Albertelli, G., 2005. Project of a software catalog of skeletal elements from Antarctic fish species, including some identification facilities. Working Group WG-FSA-05/35, CCAMLR, Hobart, Australia, October 2005, 7 pp.
 6. La Mesa M., M. Marini, 2005. Trace elements in the otoliths of the Scotia Sea icefish, *Chaenocephalus aceratus*, as an aid to discriminate different populations from the South Shetland Islands, Antarctica. 3rd International Conference on the Oceanography of the Ross Sea Antarctica, Venezia, Italy, 10-14 October 2005. Abstract.
 7. Detrich H. W., C. D. Jones, S. Kim, A. W. North, A. Thurber, M. Vacchi, 2004. Nesting behaviour of the icefish *Chaenocephalus aceratus* at Bouvetøya Island, Southern Ocean (CCAMLR Subarea 48.6). Working Group WG-FSA-04/26, CCAMLR, Hobart, Australia, October 2004, 13 pp.

D – proceedings of national meetings and conferences

1. Vannini G., Bottaro M., Bono R., Modena M., Vacchi M., 2009. First Observations on the coastal fish assemblage at Terra Nova Bay (Ross Sea, Antarctica) during the austral springtime. *Biol.Mar.Mediterr.*, 16 (1): 372-373.

E – thematic maps

1. SCAR Composite Gazetteer of Antarctica - Place name: Silverfish Bay; source: Italy (proposed by M. Vacchi); approval date: 03/10/2006; latitude 74°37' S, longitude 164°40' E; description: coastal area (78 km²) almost covered by sea ice-pack, extending from the point just West of Shield Nunatak to Oscar Point and then to the southern tip of Campbell Ice Tongue. Named because of the large presence of eggs and larvae of the "Silverfish" (*Pleuragramma antarcticum*). Reference number 18082

F – patents, prototypes and data bases

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G – exhibits, organization of conferences, editing and similar

1. Fiera di Milano, Exhibit "Mare Milano", presentation of Marino Vacchi. Title (in Italian): "Relazione tra ghiaccio marino e pesci in Antartide: cosa sta cambiando ?", (26 may 2005, Milan, Italy)
2. University of Catania: Seminary of Marino Vacchi. Title (in Italian): "Fauna ittica e Antartide: evoluzione in un ambiente unico", (22 february 2006, Catania, Italy)
3. University of Messina, Seminary of Marino Vacchi to PhD students. Title (in Italian): "La fauna ittica antartica", (28 april 2006, Messina, Italy)
4. National Antarctic Museum of Genoa, Conference of Marino Vacchi. Title (in Italian): "Vita sotto il pack antartico: strategie riproduttive dei pesci", (8 march 2007, Genoa, Italy)
5. Marine Biology Station STARESO (Corse), University of Liegi. "ICOTA Workshop STARESO". Presentation of Marino Vacchi. Title: "Ecology of Antarctic coastal fishes Terre Adelie/Terra Nova Bay France and Italy cooperation", (14 june 2007, Calvi, Corse, France).
6. University of Siena, PhD School in Polar Sciences, Seminary of Marino Vacchi: Title (in Italian): "Gestione e tutela delle risorse marine viventi antartiche", (3-5 february 2009, Siena, Italy)
7. Acquario di Genova, Exhibit "Colori, forme, voci dal mare", Conference of Marino Vacchi & Eva Pisano. Title (in Italian): "Risposte della vita al cambiamento: l'evoluzione dei pesci antartici", (13 may 2009, Genoa, Italy)

H - formation (PhD thesis, research fellowships, etc.)

1. Luisa Tartarello, thesis in Environmental Sciences, Faculty of Sciences, University of Genoa. Title (in Italian): "Osservazioni biologiche ed ecologiche sul teleosteo notothenioideo *Bovichthus diacanthus* (Carmichael, 1819) endemico di Tristan da Cunha (Atlantico meridionale)". (Marino Vacchi Co-supervisor)
2. Ilaria Ferraro, thesis in Environmental Sciences, Faculty of Sciences, University of Genoa. Title (in Italian): "Osservazioni biologiche e etologiche su esemplari della specie ittica antartica *Chionodraco hamatus* acclimatati in vasche dell'acquario di Genova". (Marino Vacchi Supervisor)
3. Massimiliano Bottaro, PhD thesis in Polar Sciences University of Siena (Cicle XX - 2004-2007). Title: "Non-Visual sensory systems of Antarctic Nototheniid fishes: Morphology, Histochemical features and ecological implications". (Marino Vacchi Supervisor)
4. Giulia Vannini, thesis in Marine Biology, Faculty of Sciences, University of Pisa, academic year 2006/2007. Title (in Italian): "Descrizione dell'ittiofauna bentonica a Baia Terra Nova (Antartide) durante la primavera australe". (Marino Vacchi Co-supervisor)
5. Michela Angiolillo, PhD thesis in Polar Sciences University of Siena (Cicle XXII - 2006-2009). Title (in Italian): "Caratterizzazione ecomorfologica e chimica di due specie antartiche di notothenioidi pelagici: *Pleuragramma antarcticum* e *Trematomus eulepidotus*". (Marino Vacchi Supervisor)
6. Roberto Palozzi, PhD thesis in Evolutionary biology and ecology, University "Tor Vergata" Rome (cicle XXII). Title: "The ontogeny of foraging in Weddell seal pups and dietary behaviour in lactating females". (Marino Vacchi Co-supervisor)

Research units

ISPRA c/o MNA-Università di Genova

Principal Investigator: Marino Vacchi

Research task: Studies on coastal fish communities of Terra Nova Bay; scientific and administrative coordination of the project

CNR-ISSIA-Robotlab, Genova

Principal Investigators: Riccardo Bono, Giorgio Bruzzone

Research task: Underwater Visual Census activity by ROV "Romeo" at Terra Nova Bay

DIBIO, Università di Genova

Principal Investigators: Carla Falugi, Eva Pisano

Research task: studies on the ontogeny and larval development of *Pleuragramma antarcticum*

Dipartimento Biologia Animale ed Ecologia Marina, Università di Messina

Principal Investigator: Antonia Granata

Research task: survey on abundance and distribution of ichthyoplankton and mesozooplankton at Terra Nova Bay

ISMAR-CNR, Ancona

Principal Investigator: Mario La Mesa

Research task: studies on age and growth of Antarctic fishes

Date: 2 may 2010

Notes