SPIXIANA	32	2	173–185	München, November 2009	ISSN 0341–8391

Ascidians from the southern Chilean Comau Fjord

(Chordata, Ascidiacea)

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Lagger, C., V. Häussermann, G. Försterra & M. Tatián (2009): Ascidians from the southern Chilean Comau Fjord (Chordata, Ascidiacea). – Spixiana **32/2**: 173-185

The benthic communities of the Comau fjord down to 30 m depth were sampled by SCUBA diving. We found twelve species of Ascidiacea belonging to seven different families of which one could only be identified to genus level: *Aplidium fuegiense* Cunningham, 1871, *Aplidium magellanicum* Sanamyan & Schories, 2003, *Aplidium variabile* (Herdman, 1886), *Didemnum studeri* Hartmeyer, 1911, *Lissoclinum* aff. *caulleryi* (Ritter & Forsyth, 1917), *Distaplia colligans* Sluiter, 1932, *Corella eumyota* Traustedt, 1882, *Alloeocarpa incrustans* (Herdman, 1886), *Cnemidocarpa nordenskjoldi* (Michaelsen, 1898), *Pyura* sp., *Pyura chilensis* Molina, 1782 and *Paramolgula gregaria* (Lesson, 1830). The species are described shortly and documented photographically. An identification key for orders and families to which the collected species belong is provided. The distribution of these species within the fjord Comau is discussed with respect to the fjord's specific conditions.

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Introduction

With an extension of more than 1,500 km, the Chilean fjord region that is composed of two mountain ranges and includes numerous fjords, islands and archipelagos is one of the largest and the most structured fjord regions in the world. However, despite the growing economic use of the area, mainly through aquaculture, its benthic communities are still very poorly known. First studies indicate a high diversity with many new species and even new communities (i.e., Försterra & Häussermann 2003, Hajdu et al. 2006, Häussermann & Försterra 2007, Van Ofwegen et al. 2007, Försterra et al. 2008).

Ascidians are benthic filter-feeders present in all kinds of benthic marine communities, distributed from the intertidal (generally under rocks) to the subtidal and the deep-sea, on all types of substrates. Recently, Lee et al. (2008) published a list of ascidians from Chile including species from the continental region to the oceanic archipelagos. The list was based on the taxonomic results of the Swedish "Lund University Chile Expedition" (Van Name 1954) and other literature (Monniot & Andrade 1983, Rozbaczylo & Castilla 1987, Clarke & Castilla 2000, Castilla et al. 2004). The ascidians of southern Chile, especially from fjordland are, nevertheless, scarcely known and only little literature on species richness exists. Ärnbäck-Christie-Linde (1929) described seven species from the Guaitecas Islands and Sanamyan & Schories (2003) found a new species of the genus *Aplidium* in the Strait of Magellan.

With the aim of inventorying the southern Chilean fjord region and creating a field guide for

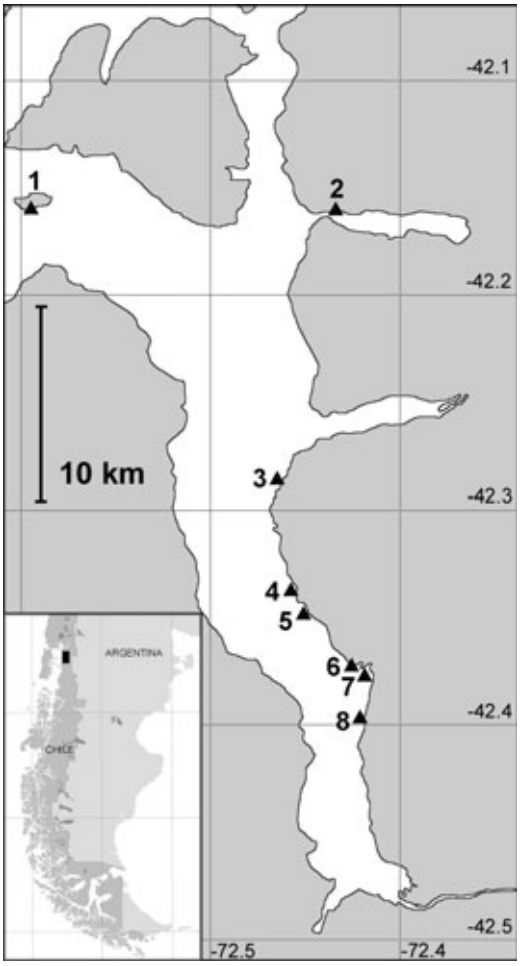

Fig 1. Map of the Comau fjord with the sampling sites.

the benthic taxa, the Huinay Scientific Field Station has been carrying out expeditions (HF1 to HF7) to remote areas of the fjord region between 2005 and 2009. In addition, the Comau fjord system in which the research center is situated has been studied in detail. A series of research papers describing the benthic taxa of Comau have been published (Schrödl et al. 2005, Melzer et al. 2006, Schwabe et al. 2006, Willenz et al. in preparation). In the present paper we describe twelve ascidian species from Comau fjord including information from the expeditions HF1 to HF4 and discuss the factors that could influence distribution of these species in Comau fjord, considering biological and physical interactions.

The study area

The Comau fjord with its depth of 350-500 m is characterized by steep slopes. The surrounding mountains that reach 2,000 m height are covered by dense extratropical rainforest with its lower limit coinciding with the maximum tide level. An annual precipitation of ~5,600 mm which was measured during the last 5 years creates a Low Salinity Layer (LSL) of a thickness between 0.5 m in summer and 10 m in winter at the head of the fjord, with minimum salinities <2 ‰ and a marked pycnocline. The LSL disappears towards the entrance of the fjord. Temperatures of the surface water vary between 5 and 6 °C in winter and more than 20 °C in summer. The LSL in combination with maximum tidal amplitudes of more than 7 m are the reason that the upper ~15 m are under regular influence of low salinity water. The main water body below the LSL offers fairly constant conditions with temperatures between 8 and 12 °C and salinities between 28 and 32 ‰.

Collection stations and methods

In September 2006, we performed a detailed bioinventory of ascidians at eight stations within the Comau fjord and the adjacent Cahuelmo and Quintupeu fjords. Additional samples were collected between 2003 and 2008. The sampling sites were: 1: Lilihuapi Island, 42°09'S 72°35'W. 2: Quintupeu entrance, 42°09'S 72°26'W. 3: Barranco Colorado, 42°17'S 72°28'W. 4: Steep wall north of Punta Llonco (SWALL), 42°19'S 72°27'W. 5: Punta Llonco, 42°20'S 72°27'W. 6: Punta Huinay, 42°22'S 72°25'W. 7: Muelle Huinay, 42°22'S 72°24'W. 8: Punta Gruesa, 42°24'S 72°25'W (Fig. 1). The samples were collected by SCUBA diving down to 30 m depth. Specimens of each species were photographed in vivo to document appearance, relationships with other organisms, placement on the bottom, substratum type, etc. Specimens were relaxed with menthol and fixed in 4 % formalin-seawater for taxonomic analysis. The samples were dissected and examined with a stereomicroscope; a light microscope was used to observe spicules and larvae. In colonial species, identification was based on at least ten zooids per colony. Reference specimens were deposited within the collection of the Museo de Zoología, Universidad Nacional de Córdoba, Argentina.

Results

A total of twelve ascidian species were identified from the eight different sampling sites (Table 1). One species could be identified to genus level only. Seven species are colonial and five solitary. In the following, we present the classification and a taxonomic identification key at family level (Kott, 1969; Monniot & Monniot, 1972, 1983) for the collected species:

Classification

Order Aplousobranchia Lahille, 1887
- Family Polyclinidae Milne-Edwards, 1841
  - *Aplidium fuegiense* Cunningham, 1871
  - *Aplidium magellanicum* Sanamyan & Schories, 2003
  - *Aplidium variabile* (Herdman, 1886)
- Family Didemnidae Giard, 1872
  - *Didemnum studeri* Hartmeyer, 1911
  - *Lissoclinum* aff. *caulleryi* (Ritter & Forsyth, 1917)
- Family Holozoidae Berrill, 1950
  - *Distaplia colligans* Sluiter, 1932

Order Phlebobranchia Lahille, 1887
- Family Corellidae Lahille, 1890
  - *Corella eumyota* Traustedt, 1882

Order Stolidobranchia Lahille, 1887
- Family Styelidae Sluiter, 1895
  - *Alloeocarpa incrustans* (Herdman, 1886)
  - *Cnemidocarpa nordenskjoldi* (Michaelsen, 1898)
- Family Pyuridae Hartmeyer, 1908
  - *Pyura* sp.
  - *Pyura chilensis* Molina, 1782
- Family Molgulidae Lacaze-Duthiers, 1877
  - *Paramolgula gregaria* (Lesson, 1830)

Key to the orders and families

1. Colonial ascidians; branchial sac without papillae, longitudinal blood vessels or folds; digestive and reproductive organs never located in the thorax. ..... Order **Aplousobranchia** 3.

– Colonial or solitary ascidians; branchial sac with papillae or longitudinal blood vessels, and sometimes folded; digestive and reproductive organs in most cases located in the thorax..... 2.

2. Zooids with body divided or not; branchial sac with papillae or longitudinal blood vessels, without folds; gonads located in the intestinal loop; oral tentacles always simple. .... Order **Phlebobranchia** 5.

– Zooids with body not divided; branchial sac with longitudinal blood vessels and, in most cases, folded; gonads on both sides of the body adhered to the mantle, of varied position; oral tentacles simple or branched. .... Order **Stolidobranchia** 6.

3. Zooids divided into thorax, abdomen and postabdomen; gonads located in the postabdomen or big part of them located under the digestive tract. ..... Fam. **Polyclinidae**

– Zooids divided into thorax and abdomen; gonads located in the abdomen. ..... 4.

4. Colonies encrusted, thin, adhered by a wide base; zooids very small (1 to 3 mm); calcareous spicules star shaped; oesophageal budding. .... Fam. **Didemnidae**

Table 1. Species found at the different sample sites in the Comau fjord.

	1 Lilihuapi Island	2 Quintupeu entrance	3 Barranco Colorado	4 Steep wall north of Punta Llonco (SWALL)	5 Punta Llonco	6 Punta Huinay	7 Muelle Huinay	8 Punta Gruesa
Aplidium fuegiense	x	x						
Aplidium magellanicum	x	x						
Aplidium variabile	x	x						
Distaplia colligans	x							
Didemnum studeri	x							
Lissoclinum aff. *caulleryi*		x						
Corella eumyota	x		x	x	x			
Alloeocarpa incrustans	x							
Cnemidocarpa nordenskjoldi		x	x					x
Pyura chilensis	x		x		x		x	
Pyura sp.			x					
Paramolgula gregaria		x						

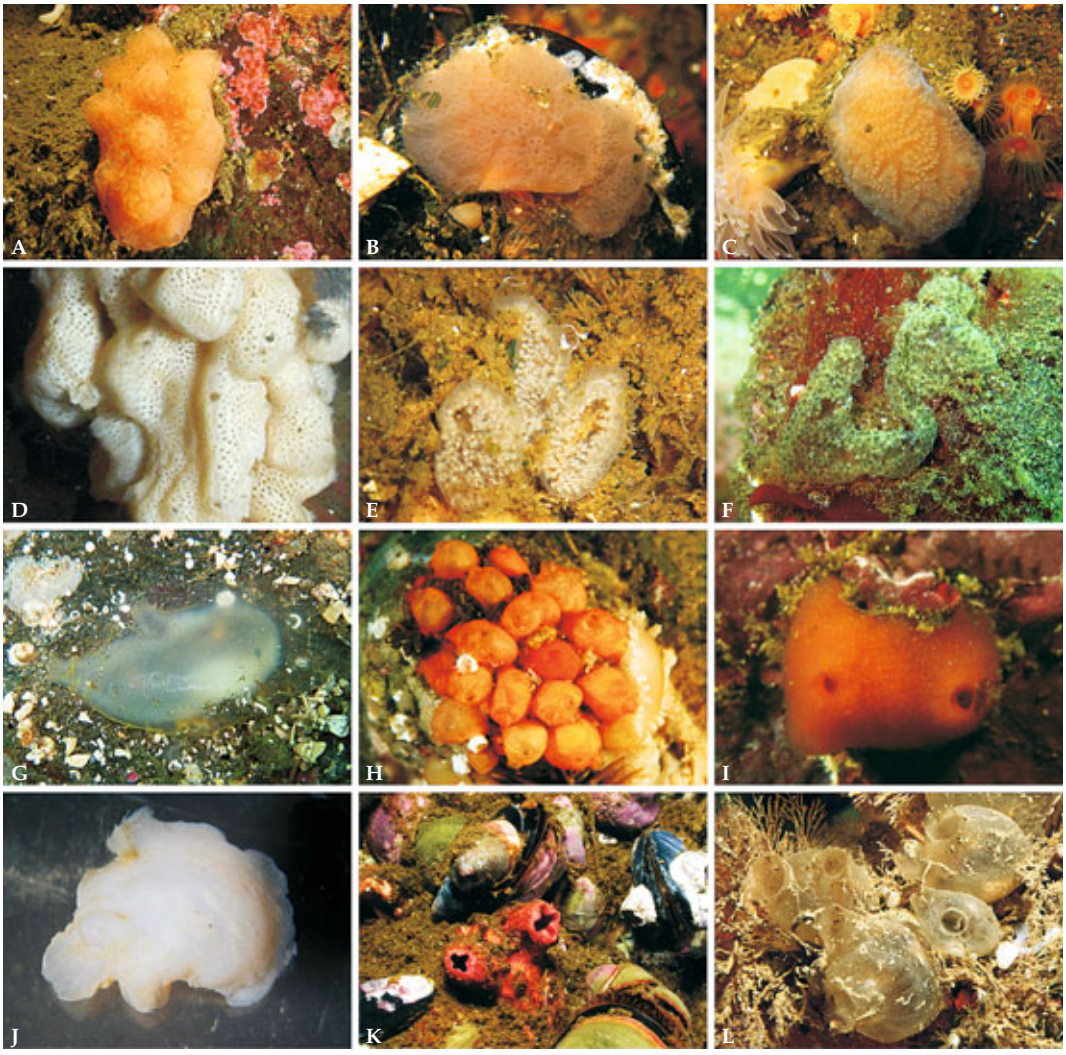

Fig. 2. Ascidians collected at Comau fjord. **A**. *Aplidium fuegiense* (×0,3); **B**. *Aplidium magellanicum* (natural size); **C**. *Aplidium variabile* (×0,5); **D**. *Didemnum studeri* (×0,5); **E.** *Lissoclinum* aff. *caulleryi* (natural size); **F**. *Distaplia colligans* (natural size); **G**. *Corella eumyota* (×0,5); **H.** *Alloeocarpa incrustans* (×1,3); **I.** *Cnemidocarpa nordenskjoldi* (x 2); **J.** *Pyura* sp. (×3); **K.** *Pyura chilensis* (×0,5); **L**. *Paramolgula gregaria* (×0,5). All pictures were taken underwater except **J** (specimen fixed).

– Colonies sometimes massive, rarely encrusted; zooids of varied size; without spicules; budding by segmentation of body or from stolons. .... Fam. **Holozoidae**

5. Ascidians with the digestive tube located at the right side of the body.....Fam. **Corellidae**

– Ascidians with the digestive tube located at the left side of the body. ..... 6.

6. Ascidians colonial or solitary; stomach without hepatic diverticula and sometimes with pyloric caecum; oral tentacles simple; 4 longitudinal folds on each side of the branchial sac or rarely without folds; branchial stigmata straight; dorsal lamina continuous.....Fam. **Styelidae**

– Ascidians solitary; stomach with hepatic diverticula and never with pyloric caecum; oral tentacles normally branched; more than 4 longitudinal folds on each side of the branchial sac or

rarely without folds; branchial stigmata straight or curved; dorsal lamina continuous or divided into a series of pointed languets. ..... 7.

7. Without renal sac in the right side of the mantle; one or two hermaphroditic gonads on each side of the body; branchial stigmata straight. ....Fam. **Pyuridae**

– Renal sac present in the right side of the mantle; one hermaphroditic gonad on each side of the body; stigmata curved, spiralled (straight stigmata are exceptional), those that are in the folds can be disposed in cones of the branchial wall. ..... Fam. **Molgulidae**

The collected ascidians

Polyclinidae

Aplidium Savigny, 1816

Aplidium fuegiense Cunningham
Fig. 2 A

Aplidium fuegiense Cunningham, 1871: 66; Monniot & Monniot, 1983: 16 [syn.]; Sanamyan & Schories 2003: 90, fig. 2a.

Material examined. Lilihuapi Island: sample Nº 3, 24.03.06, 1 colony; sample Nº 6, 26.03.06, 1 colony; sample Nº 20, 14.04.06, 1 colony, 25 m. Quintupeu entrance: sample Nº 10, 27-3-06, 1 colony.

Description

Colour orange. Shape irregular and very variable. Colonies with rounded projections.

Size. colonies from few cm up to 60 cm in diameter.

Tunic. with small, spherical pale yellow units distributed on its entire surface.

Zooids. up to 2.5 cm in length; not distributed in distinguishable systems. Branchial sac with up to 15 rows of stigmata. Cloacal siphon with simple, double or triple languet. Stomach with 5 or 6 uninterrupted folds; intestine forms a post-stomach disk.

Gonads. ovarian follicles under the intestinal curve; testicular follicles in double rows in the post-abdomen.

Larvae. rounded; with separated papillae and 4 lateral ampullae; up to 0.9 mm in length.

Habitat. Primary and secondary hard bottoms (bivalves and submerged trunks). Present in fjords, channels and at exposed coasts.

Distribution. Sub-Antarctic Islands (Kerguelen; Crozet); SW Atlantic: Patagonian shelf, Malvinas (Falkland) Islands; SE Pacific: N and S Patagonian zone (NPZ-SPZ); Tierra del Fuego, Strait of Magellan.

Biology. Larvae from February to April.

Comments. The species is very variable and might represent a species complex. Genetic studies could help to resolve this question. Likely seasonal variability or seasonal periods of regression during which the anterior parts of the zooids degenerate and the superior part of the colonies detaches, turning the tunic firmer and less transparent.

Aplidium magellanicum Sanamyan & Schories
Fig. 2 B

Aplidium magellanicum Sanamyan & Schories, 2003: 90, figs 1a, 2b-d.

Material examined. Lilihuapi Island: sample Nº 190, 17.09.06, 1 colony, 14 m; Quintupeu entrance: sample Nº 180, 16.09.06, 1 colony, 21 m.

Description

Colonies pale yellow or orange to transparent. Cushion-shaped.

Size. Up to 3 cm in diameter.

Tunic. Soft, gelatinous, without adhered particles.

Zooids. Up to 2 cm in length; distinguishable across the tunic, some parallel with others. Oral siphon with 6 pointed lobes. Cloacal siphon with simple languet. Branchial sac with up to 14 rows of stigmata, 12 to 15 stigmata for each row. Rectangular stomach with numerous folds (up to 22), some of them interrupted. Anus bilobed, situated at the level of 8th or 9th row of stigmata.

Gonads. Ovarian follicles under the intestinal curve, in first third of the post-abdomen. Testicular follicles in a line, occupying the rest of post-abdomen.

Larvae. Unknown.

Habitat. Vertical rocky walls (sometimes interspersed with boulders). Present in fjords, channels and at exposed coasts.

Distribution. SW Atlantic, SE Pacific: N and Central Patagonian zone (NPZ-CPZ); Strait of Magellan.

Biology. Unknown.

Aplidium variabile (Herdman)
Fig. 2C

Amaroucium variabile Herdman, 1886: 216, pl. XXIX, figs. 7-12.
Aplidium variabile Millar, 1960: 32 fig. 2B; Monniot & Monniot, 1983: 30 [syn.]; Sanamyan & Schories 2003: 92, figs 1b, 2e-f.

Material examined. Lilihuapi Island: sample Nº 5, 24.03.06, 1 colony; Quintupeu entrance: sample Nº 181, 16.09.06, 1 colony, 21 m.

Description
Colonies in life are pale yellow, white when preserved. Usually broadly adhered to substrate, often with peduncle. Shape approximately spherical.

Size. Colonies up to 12 cm in diameter.

Tunic. Soft and smooth; without external material (sand), neither in basal area.

Zooids. Up to 8 mm in length, grouped in parallel forming irregular complexes. Oral siphon with 6 lobes. Cloacal siphon with simple or triple languet. High number of stomach folds (12-16). Up to 15 rows of stigmata.

Gonads. Ovarian follicles at the proximal part of the post-abdomen. Testicular follicles along the whole length of the post-abdomen.

Larvae. Up to 0.7 mm in length; without intermediate papillae or lateral vesicles.

Habitat. Hard substrates. In interior fjords, channels and exposed coasts.

Distribution. SW Pacific (New Zealand); Sub-Antarctic Islands (Kerguelen; South Georgia); SE Pacific (NPZ–CPZ); Strait of Magellan.

Biology. Larvae from November to February.

Didemnidae

Didemnum Savigny, 1816

Didemnum studeri Hartmeyer
Fig. 2 D

Didemnum studeri Hartmeyer, 1911: 538; Monniot & Monniot, 1983: 43 [syn.]; Sanamyan & Schories 2003: 94, figs 3a-b.

Material examined. Lilihuapi Island: sample Nº 3 and 4, 14.04.06, 2 colonies, 23-25 m; sample Nº 194, 17.09.06, 1 colony, 8 m.

Description
Colonies white, especially around siphons due to aggregation of calcareous, star-shaped spicules; preserved whitish to grey. Cloacal openings scarce and dispersed.

Size. Colonies of variable shape and up to several cm in diameter, depending on the surface of fixation. Thin encrusted masses usually on rocks or often on other organisms.

Tunic. Smooth; without sand or epibiotic organisms.

Zooids. Small (1 mm in length), clearly visible. Branchial sac with 4 rows of stigmata and thoracic organs at the level of fourth row. Thorax and abdomen included in different layers of the colony, therefore they are difficult to extract in a whole without cutting them at the level of the oesophageal connection.

Gonads. The sperm duct makes up to 8 spiral-shaped turns on the testis.

Larvae. Without lateral vesicles; ~0.5 mm in length.

Habitat. All kinds of primary and secondary hard bottoms (thalli of algae, mussels or other organisms); common under projections or eaves of rock. Present in fjords, channels and exposed coasts.

Distribution. SW Pacific (New Zealand); Sub-Antarctic Islands (Kerguelen; South Georgia); SE Pacific (NPZ–SPZ); Tierra del Fuego.

Biology. Larvae usually present under the surface of the colony. Reproduction throughout the year.

Lissoclinum Verrill, 1871

Lissoclinum aff. *caulleryi* (Ritter & Forsyth)
Fig. 2E

Diplosoma caulleryi Ritter & Forsyth, 1917: 498.
Lissoclinum caulleryi Van Name, 1945: 114, fig. 54 [syn.]

Material examined. Quintupeu entrance: sample Nº 183, 16.9.06, 1 colony.

Description
Colony soft and glassy, transparent but with a cloudy aspect because spicules evenly scattered in the surface and basal layer of the test. Spicules small, averaging about 15 µm in diameter, rounded in shape with numerous rays truncated or broken in the tips. Zooids yellow coloured are easily seen through the tunic; arranged perpendicular to the surface, not in recognizable systems. Common cloacal apertures not evident.

Size. Colony of irregular shape, up to 2 cm in diameter, they are not encrusted masses but weakly attached on algae and hydrozoans.

Tunic. Smooth, without sand or epibiotic organisms.

Zooids. Small (1.6 mm in length); the upper side of the thorax strongly attached to the upper layer of the tunic, the abdomen is completely included in the basal layer; branchial sac with 4 rows of stigmata and 7-8 stigmata per mesh. Oral siphon with 6 pointed lobes, the atrial aperture (without cloacal languet) is a wide hole, extending from the second to the fourth stigmata range. Oesophageal buds present in all the zooids. Stomach round and smooth walled.

Gonads. Two globular testis located in the the base of the gut loop, sperm duct straight arises between the two follicles and lies along the gut. Ovary is situated between the stomach and ascending part of the intestine.

Larvae. Not found.

Habitat. All kinds of secondary bottoms (thalli of algae, ascidians, bryozoans).

Distribution. Type locality, San Diego Bay, California, also found in Juan Fernández Islands (Chile).

Biology. Embryos were found in a posterior extension of the body behind the intestinal loop, they undergo development into larvae in the common test.

Holozoidae

Distaplia Della Valle, 1891

Distaplia colligans Sluiter
Fig. 2 F

Distaplia colligans Sluiter, 1932: 7; Kott, 1969: 32, fig. 13 [syn]; Sanamyan & Schories 2003: 94, figs 3c-d, 4.

Material examined. Lilihuapi Island: sample Nº 11, 14.04.06, 1 colony; sample Nº 188, 16.09.06, 1 colony, 8 m.

Description
Colonies depressed and soft. Yellowish or transparent colour allows distinction of zooids that are arranged regularly in the entire surface and give a cloudy appearance to the colony. Cloacal openings usually not evident.

Size. Colonies up to 5 cm in length.

Tunic. Without adhered external material.

Zooids. Up to 3 mm in length. Branchial sac with 4 rows of stigmata and parastigmatic vessels; abundant longitudinal musculature that crosses the thorax and circular bands at the base of the oral siphon. Stomach wall smooth.

Gonads. Located in the intestinal loop. Female gonads less evident than testicular follicles.

Larvae. Small (0.5 mm in length); without lateral vesicles.

Habitat. Rocky bottoms. Present in fjords, channels and exposed coasts.

Distribution. Antarctica (Ross Sea; Antarctic Peninsula); Sub-Antarctic Islands (South Georgia; South Orkneys); SE Pacific (NPZ–SPZ); Strait of Magellan.

Biology. testicular follicles and ovary were observed in different stages of development in February and March.

Comments. only one previous record in South America; status in this area is uncertain. Some authors reported a purple colour in fixed colonies, which was not observed in the examined material.

Corellidae

Corella Alder & Hancock, 1870

Corella eumyota Traustedt
Fig. 2 G

Corella eumyota Traustedt, 1882: 271; Kott, 1969: 84, figs 110-112; Monniot & Monniot, 1983: 54; Turon, 1988; Lambert, G., 2004: 239-241, figs 1-2; Varela, M. M., 2007: 1-3, fig. 2.

Material examined. Lilihuapi Island: sample Nº 187, 16.09.06, 1 specimen, 11 m; sample Nº 189, 17.09.06, 1 specimen, 15 m; SWALL: sample Nº 195, 196 and 197, 20.09.06, 3 specimens, 17-20 m. Barranco Colorado: sample Nº 197, 20.09.06, 1 specimen, 16 m. Punta Llonco: sample Nº 7, 14.04.06, 1 specimen, 28 m.

Description
Body shape depressed and oval. Some specimens with short peduncle situated at the opposite side of the siphons.

Size. From a few cm up to 25 cm in length (Antarctic specimens).

Tunic. transparent, off-white or ivory; delicate.

Zooid. Cloacal siphon in the middle of the body. Branchial sac with up to 60 longitudinal vessels at each side. Stigmata curved, spiralled. Digestive tract, gonads and intestinal loop at the right side of the body.

Habitat. Different types of substrate: rocky, sandy, muddy, under rocks (intertidal); epibiotic on other ascidians, macroalgae or mussels; on harbour structures (pilings, hulls of ships). Individuals can be found in large groups. Rare in fjords, present in channels and exposed coasts.

Distribution. NE Atlantic (NE France; Rías de Galicia); SE Atlantic (Namibia); SW Atlantic (Patagonian shelf); SW Pacific (Australia; Tasmania); Antarctica; Sub-Antarctica; SE Pacific (NPZ–CPZ).

Biology. Brooding species.

Comments. High adaptation and radiation from the Southern Hemisphere. Its presence in the SW Atlantic and SE Pacific could be due to the transport of its larvae by upwelling Antarctic water masses. Its recent and sudden presence in the NE Atlantic could be due to anthropogenic factors.

Styelidae

Alloeocarpa Michaelsen, 1900

Alloeocarpa incrustans (Herdman)
Fig. 2H

Synstyela incrustans Herdman, 1886: 342.
Alloeocarpa incrustans Kott, 1969: 103, figs 141-142 [syn]; Monniot & Monniot, 1983: 67.

Material examined. Lilihuapi Island: sample Nº. 5, 14.04.06, zooids attached on *Crepidula* shell, 15 m.

Description
Zooids closely arranged between each other; united by a thin basal membrane. Colour in life is orange to yellow, preserved is greyish.

Size. Colony up to several cm depending on the surface to which it is attached.

Tunic. Soft and resistant.

Zooids. Sack-like or ovoid; up to 10 mm in length. Up to 14 oral tentacles of two sizes, alternating. Branchial sac without folds; with 9 and 8 longitudinal vessels on the right and left side of the body respectively and with transverse and parastigmatic vessels. Digestive tract perpendicular to the mid-ventral line. Stomach wall with 12-16 folds; with caecum and pyloric gland in the distal part.

Gonads. Female gonads on the right side of the body: composed of several ovaries in a single row along the ventral line with ovocytes of different sizes in each ovary and short ducts towards the dorsal area. Male gonads on the left side of the body, arranged in group; with short sperm duct.

Larvae. With adhesive papillae surrounded by a crown of ampullae.

Habitat. Hard substrates. Present in fjords and channels.

Distribution. SW Atlantic including Malvinas (Falkland) Islands; Sub-Antarctic (South Georgia island); SE Pacific (NPZ–SPZ); Strait of Magellan; Tierra del Fuego.

Biology. the larvae are incubated in the atrial cavity for less than half a year, from February to June.

Cnemidocarpa Huntsman, 1912

Cnemidocarpa nordenskjoldi (Michaelsen)
Fig. 2I

Styela nordenskjöldi Michaelsen, 1898: 365.
Cnemidocarpa nordenskjoldi Monniot & Monniot, 1983: 70, figs 13, A, B [syn.]

Material examined. Punta Gruesa: sample Nº 176 and 178, 15.09.06, 2 specimens, 20 m. Quintupeu entrance: sample Nº 184, 16.09.06, 1 specimen, 18 m. Barranco Colorado: sample Nº 200, 20.09.06, 1 specimen, 16 m.

Description
Dome or hemisphere-shaped, depressed; attached with a wide base: in this case with thin mantle and without muscular bands in the attachment area. Siphons close.

Size. up to 5 cm in diameter.

Tunic. Thin and resistant; in some specimens with some sand particles and rough appearance. Colour in life is orange or red, principally in the area of the siphons, preserved is brown.

Zooid. Branchial sac with 4 folds at each side; up to 26 longitudinal vessels (vessels rarely between folds). Cloacal siphon with atrial tentacles. Stomach with pyloric caecum; stomach wall folded. Intestine along the entire length of endostyle extending towards the right side of the body.

Gonads. Thin and long; extending to both sides of the endostyle and bending in right angle towards the cloacal opening, 2 series of parallel endocarps at each gonad.

Habitat. Hard bottoms. Some specimens associated with mussels and scallops. Present in fjords, channels and exposed coast.

Distribution. SW Atlantic (Patagonian shelf); SE Pacific (NPZ–CPZ).

Biology. Gonads mature from December to February; the development of the larvae can extend until May.

Pyuridae

Pyura Molina, 1782

Pyura sp.
Fig. 2J

Material examined. Barranco Colorado: sample Nº 201, 20.09.06, 1 specimen, 11 m.

Description
Body more or less oval, flattened; attached to the substrate with a wide area, along the ventral side. Colour whitish to greyish.

Size. 1.1 cm in length.

Tunic. Thick, without adhered foreign matter; siphonal area covered with single and short sharp spines.

Zooid. Oral siphon terminal. Cloacal siphon located on the first third of the body lenght. Both siphons 4-lobed, fairly long. Nine branched oral tentacles. Dorsal tubercle is a flattened ring, opening through a short slit on the left side, directed anteriorly. Strong musculature in the mantle wall; longitudinal muscles running along the siphons, from where they are extending all over body surface; circular muscle bands stronger in siphons. Branchial sac with 6 well defined folds on each side; with up to 11 longitudinal vessels on, and 3 between folds, according to the following formula (right side): E 0 (4)2(8)3(9)2(8)2(8)2(11)2 DL. Four right stigmata in each mesh, crossed by parastigmatic vessels. Dorsal lamina composed by a series of sharp languets.

Gonads. One gonad on the right side extending along the ventral area; composed of two parallel series of polycarp lobes joined by a long central duct opening into the atrial siphon. Anal border bilobated.

Comments. Because of its small size and strong attachment to the surface, the only available specimen was damaged during collection. The ventral part of the left side of the body is nearly destroyed, thus it was not possible to see the disposition of the gut and gonads. Therefore it is not possible to perform an identification to species level. Up to date, four pyurids are described from Chile, the well-known *P. chilensis*, the pedunculated *P. legumen*, *P. praeputialis* that is restricted to Antofagasta and *P. stubenrauchi* (characterized by only 4 branchial folds on each side) but none of those is similar to *Pyura* sp. More samples are necessary to determine the present species.

Pyura chilensis Molina
Fig. 2K

Pyura chilensis Molina, 1782: 196; Van Name, 1945: 333 [syn.]; Gutiérrez & Lay, 1965: 1-8, figs 1-35; Monniot & Monniot, 1983: 97.

Material examined. Barranco Colorado: sample Nº 201, 20.09.06, 1 specimen, 11 m. Lilihuapi Island: sample Nº 192 and 193, 17.09.06, 2 specimens, 11-12 m. Muelle Huinay: sample Nº 33, 21.04.06, 1 specimen, 20 m. Punta Llonco: 20.09.03, 1 specimen, 15 m.

Description
Sack or pear-shaped; superior area wider than the base. Body covered with sand or mud with only the siphons visible. Colour in life ivory or off-white; siphons red; preserved tunic and siphons yellow or greyish.

Size. Up to 5 cm.

Tunic. Thick; wrinkled; with abundant digitiform projections.

Zooids. Forming indistinguishable masses: often only the upper third of individuals can be visually distinguished from those masses. Siphons with 4 lobes. Strong musculature in the mantle wall. Branchial sac with 6 folds on each side of the body.

Gonads. Left gonad inside the intestinal loop; right gonad occupies the greater part of the inner wall mantle area.

Habitat. Rocky bottoms. Rare in fjords, present in channels and at exposed coasts.

Distribution. SE Pacific (from Peru to 43º SL, Chile).

Biology. Gonads mature from May to August. In the intertidal individuals are arranged either separately or in groups, in the sublitoral they form three-dimensional masses.

Comments. The mantle and internal structures are edible. The population situation is critical because of overexploitation. In protected areas there are up to 3 orders of magnitude more specimens than in exploited areas. The specimens usually reach maturity only in protected areas.

Molgulidae

Paramolgula Traustedt, 1885

Paramolgula gregaria (Lesson)
Fig. 2L

Cynthia gregaria Lesson, 1830: 157, pl. 52, fig. 3.
Paramolgula gregaria Kott, 1969: 164, figs 232-233 [syn]; Monniot & Monniot, 1983: 116.

Material examined. Quintupeu entrance: sample Nº 183, 16.09.06, 1 specimen, 21 m.

Description

Body spherical.

Size. Up to 30 cm in height. One of the largest solitary species.

Tunic. In developed specimens brown; hard and rough; in young specimens almost translucent, thin and light; with sand or epibiotic organisms (barnacles, hydrocorals, macroalgae) attached to the surface.

Zooids. Both siphons terminal. Some specimens with fine projections ("hairs") in the basal area that allows them to fix themselves to substrate, in specimens without peduncle. Sixteen oral tentacles of different sizes, branched. Dorsal tubercle in form of "C"; with opening towards the left or right body side. Branchial sac without true folds; with 7 high longitudinal vessels on each side of the body, crossed by 5 transverse vessels forming a network. This network can partially cover the stigmata. Digestive tract at posterior end of the body. Stomach partially covered by hepatic lobes. Oesophagus short. Anus bilobed.

Gonads. Hermaphroditic; aprox. spherical in shape. Left gonad included in the secondary loop of the digestive tract; right gonad connects to end of kidney.

Habitat. Primary and secondary hard substrate (on brachiopods, horny corals or gorgonians). Present in fjords and channels.

Distribution. Sub-Antarctic islands (South Georgia); SW Atlantic: Argentine shelf including Malvinas (Falkland) Islands; SE Pacific (NPZ–SPZ); Strait of Magellan; Tierra del Fuego.

Biology. Gonads mature in November, dispersion of the gametes from February to May.

Discussion

The tip of South America, comprising the Pacific and Atlantic continental coast from Chiloé Island to Valdés Peninsula (including Malvinas/Falkland Islands in the Atlantic), is characterized by cold-temperate waters, and influenced by rising masses of deep Antarctic water. This wide area, traditionally called Magellan Province (Hedgpeth 1969) was also considered a unity by Briggs (1995) and called South American Region. Monniot & Monniot (1983) quoted a total of 61 ascidian species from this area: between these species, 23 are endemic whereas 16 are also described from the Antarctic Peninsula and the South Shetland Islands. The likeness estimate between the Antarctic-Subantartic complex and the Magellan Province is strong: including recent records it is about 33 % (Tatián et al. 2005). Species like *Sycozoa sigillinoides*, *S. gaimardi*, *Distaplia cylindrica*, *Cnemidocarpa verrucosa and Corella eumyota* are characteristic elements of benthic communities in the Magellan Province and in Antarctica (Sahade et al. 1998, Tatián & Lagger in press). Of these species, only *Corella eumyota* is present in the Comau fjord. This fjord, located close to the northern end of the Magellan Province, represents the known northern limit for other Antarctic/Magellan species such as *Aplidium fuegiense*, *A. magellanicum*, *A. variabile*, *Distaplia colligans*, *Didemnum studeri*, *Alloeocarpa incrustans*, *Cnemidocarpa nordenskjoldi* and *Paramolgula gregaria*. The range distribution of the species found along the Chilean fjord region is detailed in Fig. 3.

The species *Corella eumyota* is spreading into areas like the SW Atlantic, the SE Atlantic and Europe, where specimens show a high morphological variability between populations compared to Antarctic specimens (Varela et al. 2007). The collected specimens vary in test colour from the typical translucent-ivory to redish, this latter not been described so far. A molecular study including populations from different areas (i. e., South America and Antarctica) is planned. It will use this species as a model to clarify processes like gene flux and speciation in a context of changes in the marine environment and intense trade, which facilitates the spreading of species.

In highly structured regions such as the Chilean fjord region, besides latitudinal range other factors have to be taken into account to discuss species distributions. The low salinity layer (LSL) known from the inner fjords amplifies the salinity and temperature range in the upper 10-15 m in the inner Comau fjord. This situation seems to affect the distribution of ascidians. While temperature seasonally determines reproduction and growth, abrupt salinity changes or low salinities may restrict establishment of larvae and population abundance (Dijkstra et al. 2008). According to Lambert (2005), most ascidians inhabit areas with salinities ≥25 ‰. The very low salinities registered in the inner fjord that can reach 2 ‰ represent the strongest limitation for ascidians. In the mouth of the fjord (sampling sites Lilihuapi and Quintupeu, see Table 1) we found a higher species richness, and we found the specimens at shallow depths (below 8 m: *Didemnum studeri and Distaplia colligans*). Few species were recorded from the sampling sites in the inner fjord (Fig. 1; Table 1). The same was previously found in sea anemones, whose diversity diminish from the mouth to the head (see Häussermann 2006). Polyclinid species that were not represented in the inner fjord appear to be more sensible to these physical differences. The

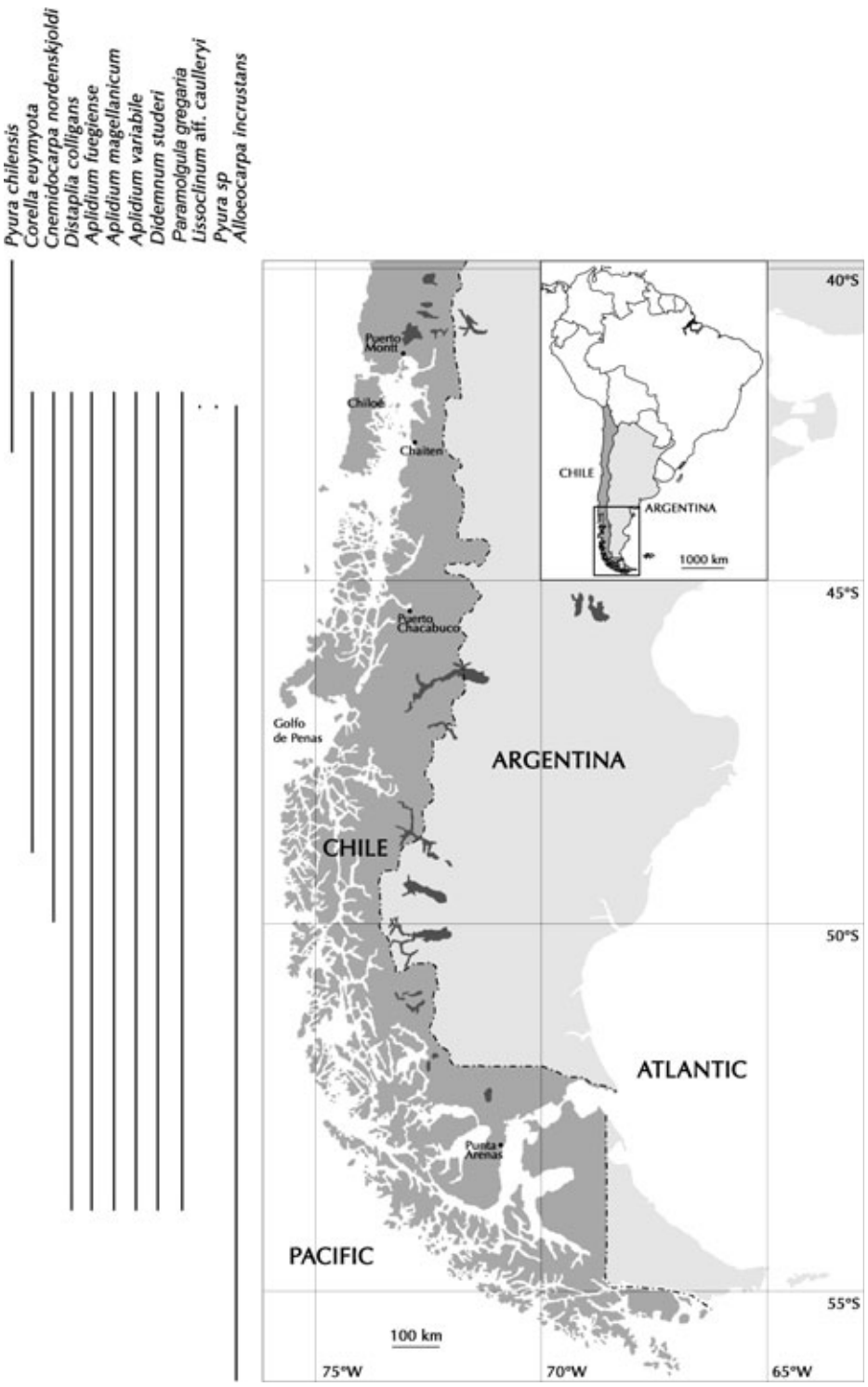

Fig. 3. Extended distribution of the specimens found along the Chilean Fjord Region.

species *Pyura chilensis* is present in different sampling sites and depths along the entire fjord. However, it is very rare in the inner fjord. Since this species is common in intertidal areas in northern localities of Chile (Castilla et al. 2004), it can cope with a wide salinity and temperature range.

The list of species from Comau fjord and the entire fjord region is for sure incomplete. In addition to the native species one introduced species is described from this region: the cosmopolitan ascidian *Ciona intestinalis* from the Strait of Magellan up to Antofagasta (Castilla et al. 2005). Further sampling and ecological and molecular studies are necessary to learn more about the abundance and distribution of these organisms and to obtain a realistic diagnosis of the state of their populations which should be a tool for scientists and users of this region.

Aknowledgements

We thank the team of the Huinay scientific station for their support with the diving basics. This is publication No. 41 of Huinay Scientific Field Station. This work was partially funded by PIP CONICET 5507; PICTO ANPCyT-DNA Nº 36326 and SECyT (05/I602), Universidad Nacional de Córdoba.

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Buchbesprechungen

10. Ptak, Roderich (Hrsg.): Tiere im alten China – Studien zur Kulturgeschichte. Maritime Asia Vol. 20, 192 pp.; Harassowitz Verl. Wiesbaden. 2009. ISBN 978-3-447-06017-7.

Aus der reichen kulturellen Vergangenheit Chinas kennen wir viele Hinweise auf Tiere, die dem Menschen der damaligen Zeit nützlich, gefährlich oder schädlich waren. Obwohl man grundsätzlich die reichen Schriftzeugnisse lesen kann, können nach wie vor eine Reihe von Schriftzeichen für Tiere noch nicht richtig gedeutet werden. Von manchen Tieren kennt man noch nicht einmal die Gattungszugehörigkeit. Dies hat immer wieder zu voreiligen Schlüssen und Fehlinterpretationen geführt. Im vorliegenden Band werden einige Tiere, die für die Menschen im alten China von Bedeutung waren, genauer untersucht, ihre zoologische Natur gedeutet und ihre kulturgeschichtliche Stellung wird dargestellt und erläutert.

Drei Beiträge behandeln Vögel, den Mandschurenkranich, *Grus japonicus*, den "kopfüber hängenden Vogel, daogua(niao), der teils als Paradiesvogel gedeutet wird, sowie den "weißen Papagei", der vielleicht ein Kakadu ist. Drei weitere Beiträge behandeln Arten der Felidae (Katzenartige), die Hauskatzen, den Mungo, *Herpestes javanicus*, sowie Leoparden und weitere Großkatzen. Es werden viele schamanische Rituale, Symbole und religiöse Dimensionen vorgestellt, die mit diesen Tieren zusammenhängen. Ein weiterer Aufsatz behandelt die Igel (insbesondere die Erinaceinae, Stacheligel), die früher offenbar zur Schädlingebekämpfung eingesetzt wurden. Schließlich wird auch der seit kurzem ausgestorbene Yangzi-Flussdelphin, *Lipotes vexillifer*, dargstellt, der früher für die Gewinnung von Lampenöl gejagt wurde und dem ein Gedicht gewidmet ist. Ein Kapitel beschäftigt sich mit einem Insekt: der sogenannte "zifang". Es handelt sich hierbei um den Orientalischen Heerwurm, d. h. die Raupen von *Leucania separata* (Lepidoptera, Noctuidae). Dieser auch heute noch bedeutsame Schädling neigt zu Massenauftreten mit Schadfraß vor allem an Weizen, Reis, Mais und anderen Kulturpflanzen. In dem Artikel werden nicht nur historische Berichte und Beschreibungen der Bekämpfung erläutert, sondern es werden auch die verschiedenen Namen und verwandte Arten sowie die aktuelle zoologische und landwirtschaftliche Bedeutung behandelt.

Das ganze Werk ist eine gelungene Kombination, in der nicht nur die Kulturgeschichte, sondern auch viele interessante zoologische Aspekte zur Sprache kommen. Ein Werk, das sowohl für Zoologen als auch allgemein uneingeschränkt zu empfehlen ist. Das Werk ist eine interessante Lektüre über die Bedeutung einzelner Tiere für den Menschen im alten China und das Verhältnis der Menschen zu den Tieren. Ein spannendes Produkt interdisziplinärer, sinologisch-zoologischer Forschung.

Klaus Schönitzer

11. Hardersen, S., F. Mason, F. Viola, D. Campedel, C. Lasen & M. Cassol (Hrsg.): Research of the natural heritage of the reserves Vincheto di Celarda and Val Tovanella and Val Tovanella (Belluno province, Italy). Conservation of two protected areas in the context of a LIFE Project. – Quaderni Conservazione Habitat, 5, 461 pp.; Arti Grafiche, Verona. 2008. ISBN 978-88-87082-98-2.

In diesem Band werden zwei Naturschutzgebiete in der Provinz Belluno (Venetien) untersucht. Das eine, Vincheto di Celarda, liegt in der Ebene am Piave-Fluss, das andere, Val Tovanella, ist ein kleines Tal in den Dolomiten. In den ersten Kapiteln werden die Naturschutzgebiete selbst, ihre Geologie, Geomorphologie und Hydrogeologie, ebenso wie die Flora ausführlich dargestellt. In weiteren Kapiteln werden von den Insekten in mehreren Kapiteln Käfer, Lepidopteren, Dipteren und Libellen dargestellt. Außerdem werden auch Pilze, Flechten, Mollusken sowie Fische und Brutvögel behandelt. Insgesamt werden in diesem sehr ausführlichen Band 21 Arten zum ersten Mal für Italien nachgewiesen. Viele weitere seltene und geschützte Arten demonstrieren sehr deutlich den hohen ökologischen Wert der beiden Naturschutzgebiete.

Der vorliegende, hervorragende Band ist in englisch und italienisch geschrieben und reichhaltig farbig illustriert. Am Ende der Einzeldarstellungen wird für die beiden Naturschutzgebiete jeweils ein Naturschutz-Plan entworfen, in dem konkrete Pflege- und Schutzmaßnahmen dargestellt werden. Es ist zu hoffen, dass diese Maßnahmen auch wirklich umgesetzt werden.

Klaus SCHÖNITZER

12. Campanaro, A., Hardersen, S. & Mason, F. (Hrsg.): Piano di gestione della Riserva naturale Statale e Sito natura 2000 "Bosco della Fontana", Quaderni Conservazione habitat 4, 221 pp.; Cierre edizioni, Verona. 2007. ISBN 978-88-8314-463-9.

Das Naturschutzgebiet Bosco della Fontana ist ein Wald in der Po-Ebene in der Provinz Mantua. In dem vorliegenden Band werden Fauna und Flora dieses Schutzgebietes sehr anschaulich dargestellt und anschaulich illustriert. Eine Reihe von Arten, die im Bosco della Fontana vorkommen sind geschützt oder selten, andere Arten sind eingeschleppt. Ein wesentliches Problem dieses Schutzgebietes ist seine Isolierung. In dem Buch werden auch Pläne für den Erhalt und eine mögliche Erweiterung des Schutzgebietes diskutiert.

Klaus Schönitzer