Studies on the ichthyofauna of the coastal waters of Ibiza (Balearic Islands, Spain)

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Abstract. In the framework of several field excursions to the Balearic Island of Ibiza (Western Mediterranean Sea) conducted every spring and autumn between 1998 and 2007, extensive studies were carried out on the structure, diversity and ecology of the coastal ichthyofauna. The ichthyofaunistic observations were made in the months of March, April, September and October in the course of snorkeling and scuba diving in the upper infralittoral of the coastal waters (0 to 40 m depth), including sandy and rocky substrates showing various degrees of exposition to sunlight and wave action, as well as sea grass beds (*Posidonia oceanica*). All in all, we were able to detect 130 species of fish distributed among 43 families. The highest diversity was shown by the Gobiidae (20 species), followed by the Blenniidae with 15, the Labridae with 14 and the Sparidae with 11 species. We also observed some species that are known to be rare in the upper infralittoral, such as *Zeus faber* for example.
Besides providing a standard species list, we also present interesting aut- and synecological data for most taxa recorded. Special attention was paid to associations between different fish species and associations between fishes and invertebrates. In some cases we observed a diminishment in species over the years (e.g. *Parablennius pilicornis* and *Scartella cristata*) which might be related to the general temperature increase in the Western Mediterranean basin, the possible loss of natural feeding resources (probably caused by the spreading of the Lessepsian neophytic alga *Lophocladia lallemandii*) and, subsequently, to dynamic shifts in the blennioid community.

Abstracto. Durante varios muestreos en la Isla Balear de Ibiza (España), cada una realizada en primavera y en otoño del 1998 hasta 2007, estudios extensivos de la estructura, la diversidad y la écología de la ichtiofauna de la región fueron efectuados.
Observaciones ichtiofaunísticas se realizaron en los meses de marzo, abril, septiembre y octubre buceando en las aguas litorales (hasta 40 metros de profundidad). Las observaciones incluyeron sustratos arenosos y rocosos, que mostraron varios grados de exposicíon al sol y oleaje. Además matas de *Posidonia oceanica* fueron muestreadas. En total hemos descubierto 130 especies de peces marinos distribuídos en 43 familias. La mayor diversidad se mostró en Gobiidae con 20 especies, seguido por los Blenniidae con 15 especies, por los Labridae con 14 especies y por los Sparidae con 11 especie. Tambien se observaron algunas especies conocidas como raras en el alto infralitoral, cano por ejemplo *Zeus faber*.
Además de proveer una lista de especies a nivel estandardizado, presentamos datos interesantes aut- y sinecológicos de la mayoría de los peces encontrados. Hemos dado atención especial a las asociaciones de especies de peces, tanto entre ellos como con respecto a las relaciones entre peces e invertebrados. En algunos casos observamos una frecuencia disminuída de especies de peces

(por ejemplo en *Parablennius pilicornis y Scartella cristata*) de las costas de Ibiza en los últimos años. Esos procesos podrían ser causados por una aumenta de temperatura en las aguas occidentales del Mar Mediterráneo. También es posible que hayan desaparecido los recursos de alimentacíon (posiblemente a causa de una extención de un invasor lessepsiano, la alga roja *Lophocladia lallemandii*) resultando en cambios de composición de la fauna de blenniidos.

Key words: Mediterranean Sea, Ibiza, fish, diversity, zoogeography, ecology, associations, *Lophocladia*

Introduction

To date, several studies dealing with the ichthyofauna inhabiting the coastal waters around the so-called Pityusic Islands, Ibiza and Formentera, have been carried out. Some contributions provide a more or less detailed overview of the pelagic and benthic fish fauna (SAN FÉLIX 1997, ARBONA SÁNCHEZ 2003), some papers discuss the species diversity and spatial distribution among a single family (PATZNER 1984, AHNELT & PATZNER 1996, PATZNER 1999a, PATZNER 1999b, HOFRICHTER & PATZNER 2000) and some provide observations on single species (PATZNER 1989, AHNELT ET AL. 1994, AHNELT & PATZNER 1995, HERLER ET AL. 1999, PATZNER 2001, PATZNER 2003).
A third field of ichthyofaunistic research is the colonisation of artificial reefs between Ibiza and Formentera (RENONES ET AL. 1998, MORENO 2002). All in all 405 species are described for the Balearic Islands, comprising 71 (17 %) cosmopolits, 69 (17 %) boreal species, 209 (52 %) centroatlantic species and 56 (14 %) endemic species (MAYOL ET AL. 2000). 55 of these 405 species belong to the Chondrichthyes. The present paper summarizes ten years of ichthyofaunistic field observations made using snorkeling and scuba diving techniques, and provides an update of all fishes ever recorded for the island of Ibiza.
The specific topography of the pityusic shelf elevation and geological dynamics allowed us to separate the island of Ibiza into two principal areas. One main area, the north-western part of the island, is dominated by steep rock walls from the Upper Cretaceous and Lower Tertiary (see description in SPIKER 1935) which tower up to at least 100 m high and, below the water surface line, reach down to a depth of 40 m or more. The southern and eastern parts have a much flatter landscape with a substratum mainly made up by Jurassic rocks (HAANSTRA 1935). The coastal relief is less sloping and appears structurally diversified by many sandy beaches. The sandy sediments extend down to 35 m in depth and are often overlaid by dense and widespread meadows of the sea grass *Posidonia oceanica* (L.) Delile. The greatest expanse of these *Posidonia* beds can be found in the Marine Reserve of Freus d'Eivissa in an area of 13 617 ha (MABILE & PIANTE 2005) in the south of the island between Ibiza and Formentera and also in the area between the Cala Conta and the islands off the coast in the bay of St. Antonio. The surface water along the eastern coast is generally influenced by southerly or easterly currents, whereas the northern and western coast is affected by those currents flowing or circulating southwards out of the Catalonian Sea (see review of HOPKINS 1985). However, the flux regime around Ibiza can be disturbed by seasonal phenomena whereby those currents running southwards between Ibiza and the Iberian Peninsula may dominate the flow pattern from August till January. In contrast, from February until the end of July Atlantic water from the Algerian basin mainly streams into the Balearic Sea via the

so-called Ibiza channel (HERBAUT ET AL. 1997). , The coastal waters of Ibiza are easily reached and populated both by those taxa only producing short-term meroplanctonic larvae or performing parental care and by fish larvae drifting with the holo- and meroplancton from both the north and the south. In theory, the local fish community and diversity may thus be considerably affected by the influence of allochthonous fish species such as alien species from atlanticotropical areas and the Red Sea (Lessepsian Migration). With this in mind, we believe it was time for a critical inventory of the fish fauna of Ibiza.

Material and Methods

Between 1998 and 2007 we conducted annual studies by visual census in the months of March and April, complemented by additional studies in the months of September and October as well as by occasional sightings by two of the authors (R.A.P. and C.H.G.M.) going back to 1980. The main studies took place at six locations around Ibiza (Fig. 1), and a few additional places were investigated at irregular intervals (Cala Nova, Cala Boix, Cala Mastella, Cala Bassa, Cala Tarida).
The observations were made while snorkelling in shallow areas or scuba-diving in deeper regions down to 40 m. In order to also gather nocturnal species or species only active during dusk and dawn, we made several night dives between 10 p.m. and 1 a.m. in the Cala Llenya, where all relevant substrates could be checked for demersal fishes. In order to properly identify taxonomically delicate species (e.g. Gobiidae, Blenniidae, Gobiesocidae) some fishes were caught with hand nets and determined in the lab. Several specimens were fixed in formaldehyde (5 to 10 %) and then transferred into alcohol (70 %). They are stored in the 'Senckenberg Museum' (Frankfurt), in the 'Naturhistorisches Museum' (Vienna) and in the 'Zoologische Staatssammlung' (Munich).
The taxonomy and scientific names of fish were taken from PATZNER & MOOSLEITNER (2003) and FROESE & PAULY (2006).

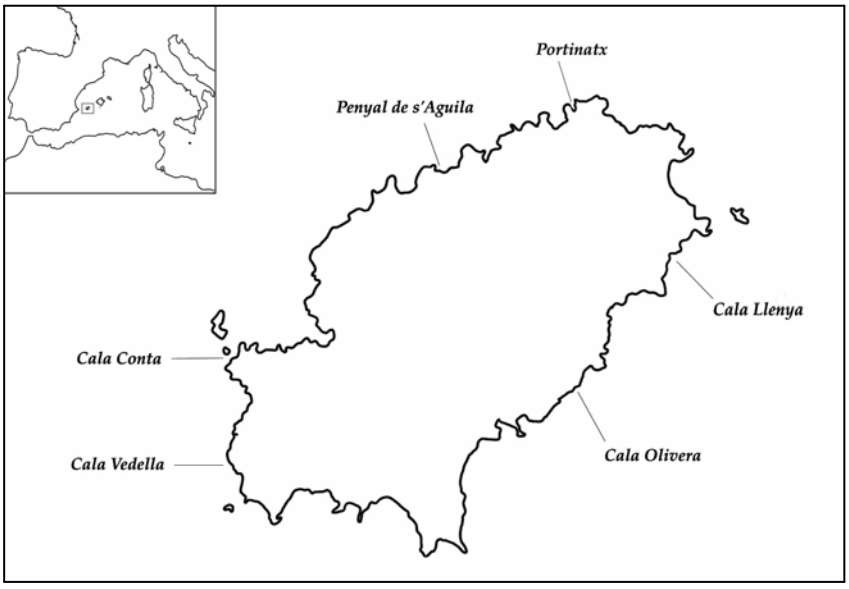

Fig.1 Investigated areas of the island of Ibiza

Results

A total of 130 species, distributed among 43 families, could be identified and thus recorded for the island of Ibiza (Tab. 1). The highest diversity is found in Gobiidae with 20 species, followed by Blenniidae with 15, Labridae with 14 and Sparidae with 11 species.

The ichthyofauna on the sandy bottoms of Ibiza is dominated by 7 species: *Bothus podas podas*, *Trachinus draco*, *Trachinus araneus*, *Uranoscopus scaber*, *Synodus saurus, Mullus surmuletus* and *Lithognathus mormyrus*. A few Sparidae and Labridae may be added to the list as commensal followers of the permanently burrowing *Mullus surmuletus*. Moreover, the pelagic species *Spicara maena* is occasionally seen on shallower sandy bottoms at night.

Table 1. List of recorded species
The habitat preferences are separated into sandy bottom (sb), rocky bottom (rb), rock pools (rp), boulder fields (bf), Posidonia (pos) and pelagic area (pel). The occurrence is described as rare (ra) when species were only detected 1-2 times, less common (lco) when species were observed irregularly and common (co) when species were found each year.

Family	Species	sb	rb	rp	bf	pos	pel
Rajidae	*Raja* cf. *miraletus* Linnaeus, 1758	ra					
	Raja radula Delaroche, 1809	ra					
Dasyatidae	*Dasyatis pastinaca* (Linnaeus, 1758)	ra					
Myliobatidae	*Myliobatis aquila* (Linnaeus, 1758)	ra					ra
Torpedinidae	*Torpedo marmorata* Risso, 1810	lco					
Clupeidae	*Sardina pilchardus* (Walbaum, 1792)						co
Synodontidae	*Synodus saurus* (Linnaeus, 1758)	co					
Muraenidae	*Muraena helena* (Linnaeus, 1758)				co		
Congridae	*Ariosoma balearicum* (Delaroche, 1809)	lco					
	Conger conger (Linnaeus, 1758)		lco				
Belonidae	*Belone belone* Linnaeus, 1761						co
Exocoetidae	*Cheilopogon heterurus* (Rafinesque, 1810)						ra
Syngnathidae	*Hippocampus guttulatus* Cuvier, 1829					ra	
	Syngnathus typhle Linnaeus, 1758					ra	
Gadidae	*Gaidropsarus mediterraneus* Linnaeus, 1758				ra		
	Phycis phycis (Linnaeus, 1766)		ra				

Zeidae	*Zeus faber* Linnaeus, 1758	ra	ra		ra	
Trachipteridae	*Trachipterus trachypterus* (Gmelin, 1789)					ra
Serranidae	*Anthias anthias* (Linnaeus, 1758)		co			
	Epinephelus caninus (Valenciennes, 1843)		ra			
	Epinephelus costae (Steindachner, 1878)		lco			
	Epinephelus marginatus (Linnaeus, 1758)		lco			
	Serranus cabrilla (Linnaeus, 1758)		co			
	Serranus hepatus (Linnaeus, 1758)	ra				
	Serranus scriba (Linnaeus, 1758)		co	co	co	
Moronidae	*Dicentrachus labrax* (Linnaeus, 1758)					ra
	Dicentrarchus punctatus (Bloch, 1792)		ra			
Apogonidae	*Apogon imberbis* (Linnaeus, 1758)		co			
Carangidae	*Seriola dumerili* (Risso, 1810)				lco	
	Trachinotus ovatus (Linnaeus, 1758)					ra
	Trachurus mediterraneus (Steindachner, 1868)					co
	Trachurus trachurus (Linnaeus, 1758)					co
Sciaenidae	*Sciaena umbra* Linnaeus, 1758		lco		lco	
Mullidae	*Mullus surmuletus* Linnaeus, 1758	co				
Sparidae	*Boops boops* (Linnaeus, 1758)					lco
	Diplodus annularis (Linnaeus, 1758)				co	
	Diplodus cervinus cervinus (Lowe, 1838)		lco	lco		
	Diplodus puntazzo (Cetti, 1777)		co	co		
	Diplodus sargus sargus (Linnaeus, 1758)		co	co		
	Diplodus vulgaris (Geoffrey Saint Hilaire, 1817)		co	co		
	Lithognathus mormyrus (Linnaeus, 1758)	co				
	Oblada melanura (Linnaeus, 1758)		co	co	co	
	Sarpa salpa (Linnaeus, 1758)		co	co	co	
	Sparus aurata Linnaeus, 1758			lco		
	Spondyliosoma cantharus (Linnaeus, 1758)					co
Centracanthidae	*Spicara maena* (Linnaeus, 1758)					co
	Spicara smaris (Linnaeus, 1758)					ra
Pomacentridae	*Chromis chromis* (Linnaeus, 1758)					co
Labridae	*Coris julis* (Linnaeus, 1758)		co	co		
	Labrus merula Linnaeus, 1758				lco	
	Labrus viridis Linnaeus, 1758				lco	
	Symphodus cinereus (Bonaterre, 1788)			lco		
	Symphodus doderleini (Jordan, 1891)				lco	
	Symphodus mediterraneus (Jordan, 1891)		co	co		
	Symphodus melanocercus (Risso, 1810)		lco			
	Symphodus melops (Linnaeus, 1758)		co	co		
	Symphodus ocellatus Forskål, 1775		co	co		
	Symphodus roissali (Risso, 1810)		co			
	Symphodus rostratus (Bloch, 1791)				lco	
	Symphodus tinca (Linnaeus, 1758)		co	co		

	Thalassoma pavo (Linnaeus, 1758)		co		co	
	Xyrichthys novacula (Linnaeus, 1758)	co				
Ammodytidae	*Gymnammodytes cicerellus* Rafinesque, 1810	lco				
Trachinidae	*Echiichthys vipera* Cuvier, 1829	ra				
	Trachinus araneus (Cuvier, 1829)	co				
	Trachinus draco Linnaeus, 1758	co				
	Trachinus radiatus Cuvier, 1829	lco				
Uranoscopidae	*Uranoscopus scaber* Linnaeus, 1758	co				
Gobiidae	*Chromogobius zebratus* (Kolombatovic, 1891)				lco	
	Corcyrogobius liechtensteini (Kolombatovic, 1891)		lco		ra	
	Didogobius splechtnai Ahnelt & Patzner, 1995		ra			
	Gammogobius steinitzi Bath, 1971		ra			
	Gobius bucchichi Steindachner, 1870			lco	co	
	Gobius cobitis Pallas, 1811				lco	
	Gobius cruentatus Gmelin, 1789		lco			lco
	Gobius fallax Sarato, 1889	lco				
	Gobius geniporus Valenciennes, 1837	co				
	Gobius niger Linnaeus, 1758		lco			
	Gobius paganellus Linnaeus, 1758			co	co	
	Gobius roulei De Buen, 1928	lco				
	Gobius vittatus Vinciguerra, 1758		lco			
	Gobius xanthocephalus Heymer & Zander, 1992		ra			
	Millerigobius macrocephalus (Kolombatovic,1891)		ra			
	Pomatoschistus bathi Miller, 1928	co				
	Pomatoschistus pictus (Malm, 1865)	co				
	Pomatoschistus sp.	co				
	Thorogobius ephippiatus (Lowe, 1839)		lco			
	Thorogobius macrolepis (Kolombatovic, 1891)		ra			
	Zebrus zebrus (Risso, 1826)		ra	lco		
Callionymidae	*Callionymus pusillus* Delaroche, 1809	lco				
Blenniidae	*Aidablennius sphynx* (Valenciennes, 1836)		co		co	
	Coryphoblennius galerita (Linnaeus, 1758)		co			
	Lipophrys canevae (Vinciguerra, 1880)		co			
	Lipophrys dalmatinus (Steindachner & Kolombatovic, 1883)		ra			
	Lipophrys nigriceps (Vinciguerra, 1883)		lco			
	Parablennius gattorugine (Brünnich, 1768)		co	lco	co	
	Parablennius incognitus (Bath, 1968)		co			
	Parablennius pilicornis (Cuvier,1829)		lco			
	Parablennius rouxi (Cocco, 1833)		lco			
	Parablennius sanguinolentus (Pallas, 1811)		co			
	Parablennius tentacularis (Brünnich, 1768)					ra
	Parablennius zvonimiri (Kolombatovic, 1892)		co			
	Paralipophrys trigloides (Valenciennes, 1836)		co	co		
	Salaria pavo (Risso, 1810)			co		
	Scartella cristata (Linnaeus, 1758)		ra			
Clinidae	*Clinitrachus argentatus* (Risso, 1810)		ra			

Tripterygiidae	*Tripterygion delaisi* Cadenat & Blanche 1971	co				
	Tripterygion melanurus Guichenot, 1845	co				
	Tripterygion tripteronotus (Risso, 1810)	co				
Bythitidae	*Oligopus ater* Risso, 1810	ra				
Carapidae	*Carapus acus* (Brünnich, 1768)	ra				
Sphyraenidae	*Sphyraena viridensis* Cuvier,1829					co
Mugilidae	*Chelon labrosus* (Risso, 1827)					co
	Liza sp.					co
	Oedalechilus labeo (Cuvier, 1829):					co
Atherinidae	*Atherina boyeri* Risso, 1810					co
	Atherina hepsetus (Linnaeus, 1758)					co
Scorpaenidae	*Scorpaena maderensis* Valenciennes, 1833	co	co			
	Scorpaena notata Rafinesque, 1810	lco	lco			
	Scorpaena porcus Linnaeus, 1758	co	co	co		
	Scorpaena scrofa Linnaeus, 1758	lco				
Dactylopteridae	*Dactylopterus volitans* (Linnaeus, 1758)	lco				
Bothidae	*Bothus podas podas* (Delaroche, 1809)	co				
Soleidae	*Solea lascaris* (Risso, 1810)	ra				
Balistidae	*Balistes capriscus* (Gmelin, 1789)	ra				
Molidae	*Mola mola* (Linnaeus, 1758)	ra				ra
Gobiesocidae	*Apletodon incognitus* Hofrichter & Patzner, 1997	lco	co	lco		
	Gouania wildenowi (Risso,1810)		lco			
	Lepadogaster candollii Risso, 1810	co	co			
	Lepadogaster lepadogaster (Bonaterre, 1788)		co			
	Opeatogenys gracilis (Canestrini, 1864)			lco		

Over rocky bottoms and boulder fields the Labridae and Sparidae occur particularly frequently, while the crevices and niches of the boulder fields and sites of large pebbles are occupied by gobies and clingfishes. The shallower regions of the rocky coast, down to 2 meters depth, and the rock pools are dominated primarily by the blennies and the threefin blennies, but the gobies *Gobius bucchichi* and *G. paganellus* are also fairly abundant when *Anemonia viridis* (Forsskål, 1775) or small stones are present. Parameters such as currents, light and natural rock cover determine which blenny species occur (ZANDER 1972a). The rock pools are mainly inhabited by *Salaria pavo*, *Paralipophrys trigloides* and *Coryphoblennius galerita*.
Beside *Chromis chromis*, which are very common in the vicinity of rocks, the main species which could be detected in the pelagic area were shoals of silversides and sardines. Mullets can also be found regularly in front of rocks, whereas needlefishes and barracudas occur more frequently in summer in the open water.

The most typical species for *Posidonia* meadows are the Sparidae *Sarpa salpa* and *Diplodus annularis*. A few Syngnathidae such as *Syngnathus typhle* and *Hippocampus guttulatus* were also seen, whereby the latter was only found once, dead, on the drift line of the beach at Cala Nova. It is difficult in other respects, too, to appoint characteristic species of *Posidonia oceanica*, because many species use *Posidonia* as a nursery area, with the adults then migrating to other habitats (GARCIA-RUBIES & MACPHERSON 1995).

Symbiosis and other associations

Feeding associations (commensalisms) were observed in *Mullus surmuletus* and *Lithognathus mormyrus* on sandy bottoms and in *Symphodus tinca* on rocky bottoms. *M. surmuletus* was usually accompanied by *Coris julis* and *Diplodus vulgaris* (Fig. 2a). In *L. mormyrus* single individuals of other species (*Diplodus vulgaris*, *Bothus podas podas* and sometimes also *Trachinus draco*) followed the group (Fig. 2b).
On sandy bottoms we detected *Bothus podas podas* (Fig. 2c) accompanying *Astropecten platyacanthus* (Philippi, 1837) or *Astropecten aranciacus* (Linnaeus, 1758) and in rocky areas larger species of *Serranus scriba* appeared with *Octopus vulgaris* (Cuvier, 1797). For further comments see 'Discussion'.
Symphodus melanocercus were regularly observed at 'cleaning stations' next to *Posidonia* meadows in the north of the island (Fig. 2d). However, by cleaning adult *Epinephelus marginatus* off Ibiza, this species does not operate cleaning stations but accompanies the large fish constantly. Some other Labridae were observed displaying cleaning behaviour only as juveniles (e.g. *Coris julis* and *Thalassoma pavo*).
Cleaning behaviour was also observed in the shrimp *Lysmata seticaudata* (Risso, 1816), cleaning *Muraena helena*.
In rocky areas *Gobius bucchichi* was always found in the vicinity of *Anemonia viridis* (Fig. 2e). This species usually rests close to the tentacles of the anemone without having any contact to them. When threatened it flees through the tentacles towards the column of the anemone but not between the tentacles close to the mouth of the anemone.
In the pelagic area juveniles of *Trachurus mediterraneus and T. trachurus* were regularly found close to *Cotylorhiza tuberculata* (Macri, 1778), at Portinatx once also to *Pelagia noctiluca* (Forsskål, 1775) (Fig. 2f).
Only once was *Carapus acus* observed, when it left a *Holothuria tubulosa* (Gmelin, 1788) in an aquarium.

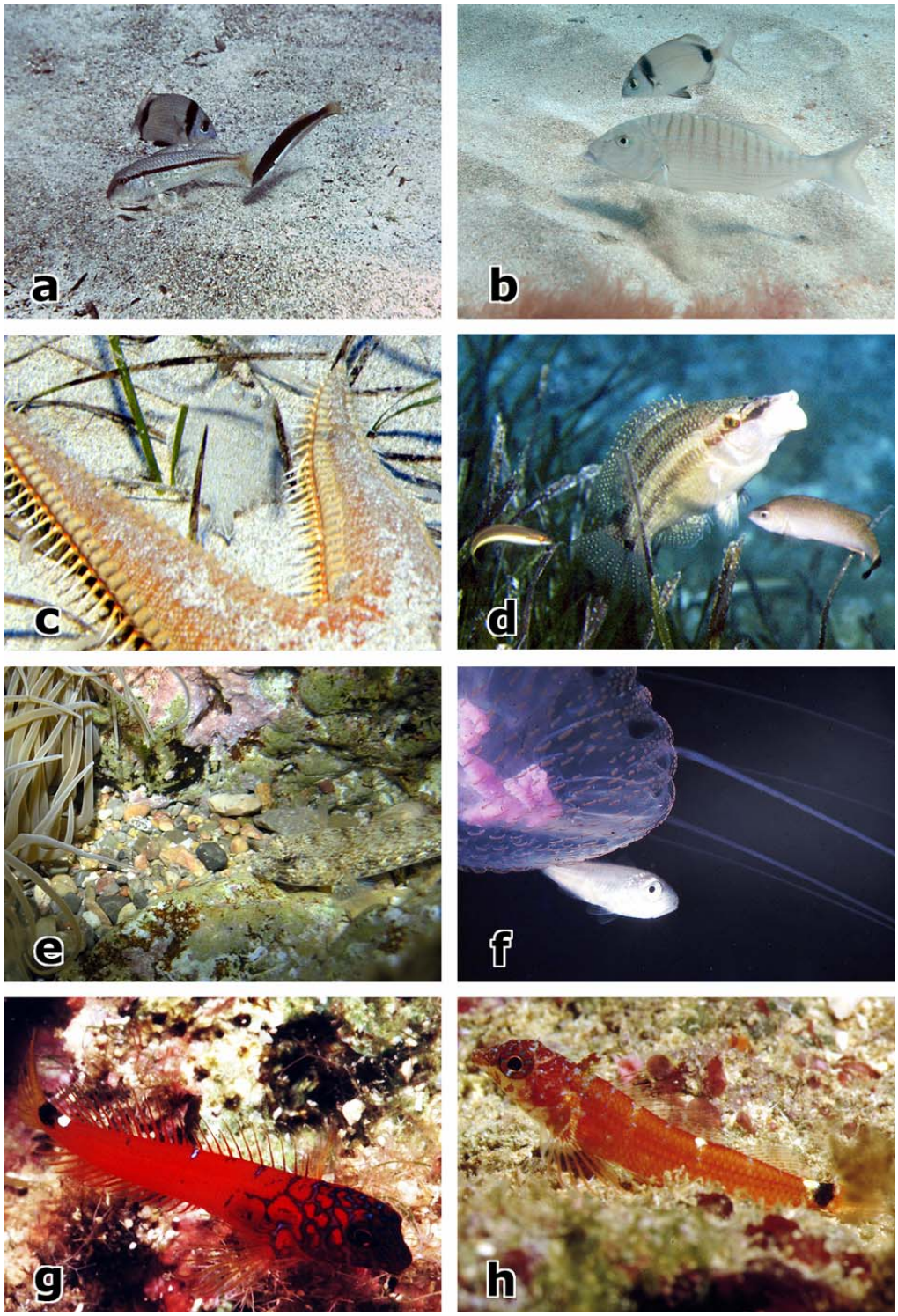

Fig. 2 Associations between fishes and fishes and between fishes and invertebrates around Ibiza. a) feeding association between *Mullus surmulletus* on the one hand and *Diplodus vulgaris and Coris julis* on the other; b) feeding association between *Lithognathus mormyrus* and *D. vulgaris*; c) association between *Bothus podas* and *Astropecten aranciacus*; d) *Symphodus melanocercus* cleaning *Symphodus tinca*; e) *Gobius bucchichi* in typical resting position in front of *Anemonia viridis*; f) *Trachurus* sp. on *Pelagia noctiluca*; g) *Lipophrys nigriceps*; h) *Tripterygion melanurus*, a doubtful mimicry of *L. nigriceps*.

In the following the occurrence of the individual species is described in detail.

Family Rajidae

Raja cf. *miraletus* Linnaeus, 1758
The brown ray normally occurs in areas deeper than 50 m and was only detected once in the Cala Llenya. The juvenile species of about 35 cm in length was caught at 6 m depth on sandy bottoms.

Raja radula Delaroche, 1809
The rough ray was only found once as a juvenile in the Cala Nova. The species was observed in shallow water at a depth of 1 m on sandy bottoms.

Family Myliobatidae

Myliobatis aquila (Linnaeus, 1758)
The common eagle ray was only observed once in the Cala Llenya in March 2007 at a depth of 16m over sandy bottoms.

Family Dasyatidae

Dasyatis pastinaca (Linnaeus 1758)
Juveniles of the common stingray were found on sandy bottoms at a depth of 4 to 5 m at the Cala Nova and at 10 m at Cala Charraca near Portinatx.

Torpedinidae

Torpedo marmorata Risso, 1810
The spotted torpedo was only found a few times on sandy bottoms in the Cala Llenya at depths of 5 to10 m.

Family Clupeidae

Sardina pilchardus (Walbaum, 1792)
The European pilchard was regularly observed in big shoals in protected shallower areas especially at times when stronger swell occurred. The juveniles (and the adults at night) can be found near the water surface. Range of depth: 0 to 20 m.

Family Synodontidae

Synodus saurus (Linnaeus, 1758)
The Atlantic lizardfish is common on sandy bottoms in the south of the Island and was found at a depth of between 2 to 20 m.

Family Muraenidae

Muraena helena (Linnaeus, 1758)
The Mediterranean moray is very common and was regularly found all around the island in rocky areas, boulder fields and at night also in *Posidonia* meadows.

Family Congridae

Ariosoma balearicum (Delaroche, 1809)
This species was only found twice on sandy bottoms: once as a juvenile of about 7 cm in length at the Cala Conta and another time at the Cala Nova. Range of depth: 5 to 10 m. The juvenile species in the Cala Conta was caught during daytime by chance, when sieving sand through a handnet (Fig. 3a).

Conger conger (Linnaeus, 1758)
The conger eel is a common species in rocky areas all around the island, inhabiting crevices and small caves. Range of depth: 3 to 35 m.

Family Belonidae

Belone belone Linnaeus 1758
The garpike was commonly found near the water surface in the open water, where it mostly occurred in small shoals of 5 to 10 individuals.

Family Exocoetidae

Cheilopogon heterurus (Rafinesque, 1810)
Mediterranean flying fish were observed twice at Cala Charraca near Portinatx, twenty years ago.

Family Syngnathidae

Hippocampus guttulatus Cuvier, 1829
The long-snouted seahorse was only found once, dead, on the shore line of the Cala Nova.

Syngnathus typhle Linnaeus, 1758
The broad-nosed pipe-fish has a perfect camouflage. It was detected in a *Posidonia* meadow at the Cala Llenya at a depth of 4 m and between ruptured leaves of *Posidonia* at 5 m depth at Portinatx.

Family Gadidae

Gaidropsarus mediterraneus Linnaeus, 1758

The shore rockling was only caught once in the boulder field in the Cala Llenya in 2002 at a depth of 1 m and twice in rock pools in Portinatx.
Phycis phycis (Linnaeus, 1766)
The forkbeard was observed once in a cave at 15 m depth at Portinatx.

Family Zeidae

Zeus faber Linnaeus, 1758
Two juvenile species of the john dory of about 30 to 40 cm in length were observed during a night dive in the Cala Llenya in autumn 2006 (Fig. 3b). Both species were found over sandy bottoms next to *Posidonia* meadows.

Family Trachipteridae

Trachipterus trachypterus (Gmelin, 1789)
After a storm a larvae of the ribbon fish was found in a bay at Portinatx at a depth of 2 m.

Family Serranidae

Anthias anthias (Linnaeus, 1758)
The swallowtail sea perch is very common at Portinatx and was regularly found on rocky bottoms beyond a depth of 25 m. Occasionally this species was also found at a depth of 15 m.

Epinephelus caninus (Valenciennes, 1843)
The dogtooth grouper was once observed at 40 m depth on a rocky bottoms at Portinatx.

Epinephelus costae (Steindachner, 1878)
The gold blotch grouper was noted in front of a big rock way out in the Cala Llenya at a depth of 12 m and was seen regularly at Portinatx at depths of between 15 and 25 m.

Epinephelus marginatus (Linnaeus, 1758)
Adult dusky groupers were observed out in the open in deeper areas (around 20 m). In autumn many juvenile groupers could be found at depths of up to 5 m, inhabiting caves and crevices in the Cala Llenya and around Portinatx.

Serranus cabrilla (Linnaeus, 1758)
The comber or learned rockfish is also a very common species, occurring mostly at depths of over 3 m on rocky bottoms and above small sandy areas.

Serranus hepatus (Linnaeus, 1758)
Brown combers are rare off Ibiza and there are only two records each for the south of the island (Cala Llenya) and for the northern coast.

Serranus scriba (Linnaeus, 1758)
The painted comber is the most common Serranidae off Ibiza and inhabits rocky bottoms and the edges of *Posidonia* meadows. Range of depth: between 2 and 20 m. Large adults can be found close to *Octopus vulgaris*.

Family Moronidae

Dicentrarchus labrax (Linnaeus, 1758)
The European sea bass was once observed at a depth of 1 m at Portinatx.

Dicentrarchus punctatus (Bloch, 1792)
The spotted sea bass was only detected once in autumn 2006 at the Cala Boix at a depth of 1 m, hunting at a shallow rocky reef on sandy bottoms.

Family Apogonidae

Apogon imberbis (Linnaeus, 1758)
The cardinal fish is very common in shaded areas of crevices, caves and ledges in depths of between 2 and 35 m. It can also be found sporadically in *Posidonia* meadows.

Family Carangidae

Seriola dumerili (Risso, 1810)
The greater amberjack, which occurs at depths of between 4 and 20 m, is not common off Ibiza. However, in September and October large groups of juveniles (20 to 30 cm in length) can regularly be observed around Portinatx.

Trachinotus ovatus (Linnaeus, 1758)
Juveniles of the derbio can be found beneath the water surface, where they occur mainly in the months of summer.

Trachurus mediterraneus (Steindachner, 1868)
The Mediterranean horse mackerel was regularly observed on night dives in the Cala Llenya at a depth of 8 to 16 m. Juveniles were found in association with the jellyfish *Cotylorhiza tuberculata*.

Trachurus trachurus (Linnaeus, 1758)
Juveniles of the Atlantic horse mackerel were regularly observed in association with the jellyfish *Cotylorhiza tuberculata* and most probably once also with *Pelagia noctiluca* (see ‘Discussion’).

Family Sciaenidae

Sciaena umbra Linnaeus, 1758
The brown meagre was observed at the entrances of caves, in *Posidonia* meadows and around rocks near *Posidonia*. Range of depth: between 2 and 15 m.

Family Mullidae

Mullus surmuletus Linnaeus, 1758
The striped red mullet is a very common species, often in a feeding association with labrids and/or sparids (Fig. 2a) on sandy or rocky bottoms at a depth of 1 to 25 m.

Family Sparidae

Boops boops (Linnaeus, 1758)
The bogue can be found over sea grass meadows as well as over rocky bottoms and sandy bottoms at depths of between 2 and 30 m.

Diplodus annularis (Linnaeus, 1758)
Annular seabreams were regularly found on *Posidonia* meadows between 2 and 20 m deep.

Diplodus cervinus cervinus (Lowe, 1838)
The zebra seabream is less common than the other *Diplodus* species and was observed on rocky bottoms as well in boulder fields at a depth of between 2 and 20 m. It was never observed around Portinatx.

Diplodus puntazzo (Cetti, 1777)
The sharp snout seabream is also less common and mainly observed as single individuals in boulder fields and next to *Posidonia* meadows at depths of between 1.5 and 20 m.

Diplodus sargus sargus (Linnaeus, 1758)
The white seabream is a very common seabream occurring over boulder fields and rocky bottoms between 2 and 20 m deep. At night this species can also be detected on the border areas of *Posidonia* meadows.

Diplodus vulgaris (Geoffrey Saint Hilaire, 1817)
The common two-banded seabream is Ibiza's most common Sparidae. It mainly inhabits rocky bottoms covered with algae, and boulder fields, but can also be observed following *Mullus surmuletus* or *Lithognathus mormyrus* over sandy bottoms (Fig. 2a, 2b). Range of depth: between 2 and 20 m.

Lithognathus mormyrus (Linnaeus, 1758)
The striped seabream is common on sandy bottoms around the island at depths of between 2 and 20 m. Due to its feeding habits, it is followed by other species, but unlike with *Mullus surmuletus* it is followed by single individuals, not by shoals (Fig. 2b).

Oblada melanura (Linnaeus, 1758)
The saddled seabream is very common off Ibiza at depths of between 1 and 20 m. Juveniles can be found in large shoals during the summer.

Sarpa salpa (Linnaeus, 1758)
The sarp is a very common fish all around the island. It forms big shoals over *Posidonia* meadows, algae covered rocky bottoms and boulder fields at depths of between 2 and 20 m.

Sparus aurata Linnaeus, 1758
The gilthead seabream was detected irregularly in the boulder fields of Cala Llenya at depths of between 3 and 8 m.

Spondyliosoma cantharus (Linnaeus, 1758)
The black seabream was observed regularly at Portinatx between 10 and 20 m.

Family Centracanthidae

Spicara maena (Linnaeus, 1758)
The blotched picarel was observed in great shoals over *Posidonia* at depths of between 10 and 20 m during the day as well as on sandy bottoms and on the edge of *Posidonia* meadows at night. At Portinatx a huge shoal was observed on every dive for over 20 years at a certain point 35 m in depth.

Spicara smaris (Linnaeus, 1758)
The picarel was seen in small groups at around 10 m at Portinatx.

Family Pomacentridae

Chromis chromis (Linnaeus, 1758)
The damselfish was abundant near large rocks at depths of between 3 and 30 m.

Family Labridae

Coris julis (Linnaeus, 1758)
The rainbow wrasse was found mainly in boulder fields and over rocky bottoms at depths of between 1.5 and 25 m. The species is common all around the island.

Labrus merula Linnaeus, 1758
This shy species is less common than the *Symphodus* species. The brown wrasse occurs individually in *Posidonia* meadows or around rocks near sea grass meadows at depths of between 4 and 20 m.

Labrus viridis Linnaeus, 1758
Like *L. merula*, the green wrasse is very shy and not very common. It inhabits *Posidonia* meadows and algae covered rocky bottoms on the edges of the meadows at depths between 3 and 20 m.

Symphodus cinereus (Bonaterre, 1788)
The grey wrasse is not common around Ibiza and was observed in the boulder field covered with algae in the Cala Llenya and at Portinatx between 1.5 and 5 m.

Symphodus doderleini (Jordan, 1891)
Doederlein's wrasse is not common around Ibiza and was only found a few times in *Posidonia* meadows at the Cala Llenya between 3 and 10 m.

Symphodus mediterraneus (Jordan, 1891)
The axillary wrasse is common in the boulder fields in the Cala Llenya and Portinatx where it could be observed building nests on *Cystoseira* covered rocks in spring and early summer. Range of depth: 0.5 to 20 m.

Symphodus melanocercus (Risso, 1810)
The black-tailed wrasse can regularly be observed cleaning other fishes at depths of between 5 and 20 m, especially around Portinatx. This species operates specific 'cleaning stations', usually at prominent points near *Posidonia* meadows (Fig. 2d).

Symphodus melops (Linnaeus, 1758)
The cockwing wrasse is common all around the Island, occurring on? algae covered rocky bottoms and in boulder fields at depths of between 1 and 20 m. Off Ibiza this species shows several colour variations.

Symphodus ocellatus Forskål, 1775
The eyed wrasse was regularly detected on algae covered rocky bottoms as well as in boulder fields at depths of between 1 and 20 m. In spring and early summer it builds breeding nests.

Symphodus roissali (Risso, 1810)
The five-spotted wrasse is the most common Labridae off Ibiza, inhabiting algae covered rocky bottoms and boulder fields at depths of between 1 and 20 m. This species showed several colour variations off Ibiza.

Symphodus rostratus (Bloch, 1791)
The long-snouted wrasse is less common than other Labridae off Ibiza and was only found a few times in *Posidonia* meadows at depths of between 5 and 10 m. Most individuals were yellow-greenish in color, though some are brownish.

Symphodus tinca (Linnaeus, 1758)
The peacock wrasse can be found all around the island in a feeding association with other labrids above rocky bottoms and in boulder fields at depths of between 1.5 to 20 m.

Thalassoma pavo (Linnaeus, 1758)
The ornate wrasse is very common on rocky bottoms and in boulder fields. Range of depth: 1 to 20 m.

Xyrichthys novacula (Linnaeus, 1758)
The pearly razorfish was detected all around the island on sandy bottoms between 3 and 25 m deep.

Family Ammodytidae

Gymnammodytes cicerellus Rafinesque, 1810
A shoal of juvenile Mediterranean sand eels was observed once in the Cala Llenya over sandy bottom at a depth of 4 meters. Two species were caught with a handnet for proper determination. Another shoal of sand eels was detected in the Cala Conta at a depth of 3 m, but no species could be caught for an accurate identification.

Family Trachinidae

Echiichthys vipera Cuvier, 1829
The lesser weever was only detected once on sandy bottom in the Cala Tarida at a depth of 1 m.

Trachinus araneus (Cuvier, 1829)
The spotted weever is less common than *Trachinus draco* but is found, including in its adult form, in shallow water at about 2 m depth. This species is more aggressive than the other weever fishes and reacts by showing its black dorsal fin when the observer comes too close to it (within a range of about 2 to 3 m).

Trachinus draco Linnaeus, 1758
The greater weever is the most common Trachinidae off the island of Ibiza, inhabiting sandy bottoms between 3 and 20 meters. Observation made by R.A.P.: this species reacts to the electronic flashlight of underwater photography.

Trachinus radiatus Cuvier, 1829
The starry weever is less common than the other weevers, and was only detected twice in the Cala Llenya at a depth of 16 m and once at Portinatx at 20 m on sandy bottoms. It seems to inhabit deeper areas, because it can regularly be found on fish markets.

Family Uranoscopidae

Uranoscopus scaber Linnaeus, 1758
The Atlantic stargazer is common on the southern coast on sandy bottoms at a depth of between 5 and 10 m, but less common in the north of the island. It was never observed in the area of Portinatx.

Family Gobiidae

Chromogobius zebratus (Kolombatovic, 1891)
Kolombatovic's goby is rare around Ibiza. It seems to inhabit boulder fields in water depths from 5 to 12 m.

Corcyrogobius liechtensteini (Kolombatovic, 1891)
In the rocky littoral of northern Ibiza, Liechtenstein's goby is the most common cryptobenthic gobiid fish. It is found frequently at depths of 3 to 25 m mostly in holes made by *Lithophaga lithophaga* (Linnaeus, 1758) or in caves.

Didogobius splechtnai Ahnelt & Patzner, 1995
Splechtna's goby was found only on the northern coast of Ibiza in caves of varying sizes. The depth was usually between 7 and 20 m. The shallowest finding was at 4.5 m in a relatively protected bay, and the deepest 40 m. The animals are usually found at the furthest end of the cave (Fig. 3c).

Gammogobius steinitzi Bath, 1971
Steinitz's goby was also only found in caves at depths of between 7 and 25 m. It settles on the walls and ceilings of deep regions of caves.

Gobius bucchichi Steindachner, 1870
Bucchich's goby was regularly found all around the island in rocky areas, boulder fields and small sandy areas, usually in the vicinity of *Anemonia viridis*. Depth range: between 2 and 20 m.

Gobius cobitis Pallas, 1811
The giant goby was found only a few times in a small cavity with sandy bottom in the Cala Llenya and in boulder fields at Portinatx at a depth of 0.5 to 1.5 m.

Gobius cruentatus Gmelin, 1789
The red-mouthed goby can be detected on rocky bottoms as well as in *Posidonia* meadows and in caves on sandy bottom. Range of depth: between 4 and 20m.

Gobius fallax Sarato, 1889
Sarato´s goby was found several times on sandy bottoms near shelter at Portinatx at depths of between 5 and 7m.

Gobius geniporus Valenciennes, 1837
The slender goby occurs on sandy bottoms at a depth of between 2 and 20 m, frequently near *Posidonia* meadows, and was also detected on sandy bottom in a cave in the Cala Olivera.

Gobius niger Linnaeus, 1758
The black goby was only observed once in the Cala Llenya in a crevice on rocky bottom at a depth of 4 m in spring 2004.

Gobius paganellus Linnaeus, 1758
The rock goby is common in boulder fields in shallow water of 0.5 to 2 m in depth and can sometimes be found in rock pools.

Gobius roulei De Buen, 1928
Roule´s goby was found a few times on sandy bottoms at a depth of 20 m at Cala Olivera as well as at Cala Vedella and near Portinatx at the same depth.

Gobius vittatus Vinciguerra, 1758
The striped goby inhabits secondary hard bottoms below a depth of 15 m and is not common around Ibiza.

Gobius xanthocephalus Heymer & Zander, 1992
The yellow-headed goby was found twice off the northern coast at Portinatx in depths of 25 and 35 meters.

Millerigobius macrocephalus (Kolombatovic, 1891)
The large-headed goby is rare around Ibiza. It was found in small cavities, under sea urchins, and in caves at depths of between 4 and 25 m.

Pomatoschistus bathi Miller, 1928
Bath's goby can be found on sandy bottoms off Ibiza at a depth of 5 to 15 m. In spring it forms shoals of juveniles occurring over *Cymodocea*-meadows.

Pomatoschistus pictus (Malm, 1865)
Like *P. bathi* the picted goby can be observed over sandy bottoms and in shoals over *Cymodocea* in spring at depths of between 5 and 15 m.

Pomatoschistus sp.
Due to problems determining small juvenile *Pomatoschistus* species it can be supposed that other species such as *P. bathi* and *P. pictus* can be found around Ibiza.

Thorogobius ephippiatus (Lowe, 1839)
The leopard-spotted goby was observed at a depth range of between 12 and 45 m resting on the sandy bottom in the rear third of caves. It reacts very shyly to the light of a diving lamp.

Thorogobius macrolepis (Kolombatovic, 1891)
The large-scaled goby was found at depths of between 37 and 45 m at Portinatx in habitats similar to those preferred by *T. ephippiatus*.

Zebrus zebrus (Risso, 1826)
This species is usually found in rock pools in the south and the north of the island. In addition it uses a variety of other habitats at depths from 0.1 to 10 m; hiding under stones, in small cavities, in holes made by *L. lithophaga*, and in association with the sea urchins *Paracentrotus lividus* and *Arbacia lixula*.

Family Callionymidae

Callionymus pusillus Delaroche, 1809
This species is less common on sandy bottoms off Ibiza and was observed at depths of between 1 and 10 m.

Family Blenniidae

Aidablennius sphynx (Valenciennes, 1836)
This is the most common blenny off the island of Ibiza and can be found on flat rocks at depths of 0 to 2 m. This species occurs on bare rocks (or only vegetated by small green algae) as well as on densely vegetated rocks.

Coryphoblennius galerita (Linnaeus, 1758)
Montagu's blenny can be found in the surf zone both below and above the water surface on rocky bottoms and in rock pools. They are most commonly observed outside the water at night.

Lipophrys canevae (Vinciguerra, 1880)
The yellow-cheeked blenny prefers the steep faces of the northern coast, where it inhabits empty *L. lithophaga* holes near the water surface. Range of depth: 0.2 to 1 m.

Lipophrys dalmatinus (Steindachner & Kolombatovic, 1883)
This species is less common around Ibiza and has been detected at Portinatx and in the Cala Vedella between algae on rounded stones in shallow waters from 0 to 1.5 m.

Lipophrys nigriceps (Vinciguerra, 1883)
The specimens occurring around Ibiza are of the subspecies *L. n. portmahonis* Castanos, 1933 (Fig. 2g). They are found in cavities of varying sizes and withdraw into empty *Lithophaga* holes when disturbed. With a few exceptions, this species is only found on the ceiling and the upper parts of the walls of cavities at depths of between 2 and 10 m.

Parablennius gattorugine (Brünnich, 1768)
This is a common species inhabiting rocky bottoms between 2 and 25 m. It is also found in crevices on steep faces in the north of the island as well as in boulder fields and on rocky bottoms in the south.

Parablennius incognitus (Bath, 1968)
The ponti blenny occurred on steep faces as well as on densely vegetated rocks all around the island and inhabits empty *Lithophaga lithophaga* holes. Range of depth: between 0.5 and 2 m.

Parablennius pilicornis (Cuvier, 1829)
The ringneck blenny was found on rocky bottoms covered with algae at depths of 2 to 5 m. Different colour variations were found: (1) cross band colouration (Fig. 3e), (2) longitudinal colouration in juveniles and some females, (3) black colouration only in breeding males, (4) yellow colouration (Fig. 3f) in around 10 % of females (Patzner & Moosleitner 1994b). In recent years the species was found less often than in earlier years and was last detected in 2004 at the Penyal de s`Aguila (see 'Discussion').

Parablennius rouxi (Cocco, 1833)
The striped blenny was detected at depths of between 7 and 35 m, mainly at entrances of small cavities on rocky bottoms.

Parablennius sanguinolentus (Pallas, 1811)
The rusty blenny is found both in the north of the island at the Penyal de s´Aguila on flat rocks covered by small green algae and in eutrophic places such as the Cala Llenya at depths of between 0 and 2 m. This species is also very common in the Cala d´Hort.

Parablennius tentacularis (Brünnich, 1768)
The horned blenny was only found once on the edge of *Posidonia* at Portinatx at 30.5 m depth. Normally this species occurs at depths of between 3 and 15 m.

Parablennius zvonimiri (Kolombatovic, 1892)
Zvonimir´s blenny is very common in shaded areas in crevices, caves and under ledges on the steep faces of the northern coast and can be found at depths of up to 5 m.

Paralipophrys trigloides (Valenciennes, 1836)
This blenny can be found in the same places as *Coryphoblennius galerita* and can also be observed outside the water at night.

Salaria pavo (Risso, 1810)
High numbers of peacock blenny individuals can be found in rock pools and were also observed in the salt flats (Salinas) in the south of Ibiza in salt concentrations up to a salinity of 65 (Patzner & Moosleitner, 1994a)!

Scartella cristata (Linnaeus, 1758)
The molly miller inhabits areas beneath the water surface on rocky bottoms (Fig. 3d). Although this species was found both in the north and in the south of the island years ago, it was not recorded after the year 2000 until March 2007 (see 'Discussion'), when we found one individual in an empty *L. lithophaga* hole at a depth of 0.5m in the Cala Llenya. This species was caught with a handnet to avoid a misidentification.

Family Clinidae

Clinitrachus argentatus (Risso, 1810)
The cline was caught a few times in the interstice of *Cystoseira* algae at depths of 0.1 to 1.5 m in the Cala Llenya.

Family Tripterygiidae

Tripterygion delaisi Cadenat & Blanche, 1971
The yellow black-faced triplefin occurs at depths below 3 to 4 m and is found all around the island on rocky bottoms.

Tripterygion melanurus Guichenot, 1845
The pygmy black-faced blenny can be found all around the island inhabiting shaded areas on rocky bottoms mostly underneath ledges (Fig. 2h).

Tripterygion tripteronotos (Risso, 1810)
The red black-faced triplefin is very common in shallow waters 0.2 to 2 m deep on rocky bottoms and is more exposed to the observer than *T. melanurus*.

Family Bythitidae

Oligopus ater Risso, 1810
The black faufre was observed in a deep cavity at Portinatx at a water depth of 12 m. Two juveniles were caught in a small cavity at 25 m depth.

Family Carapidae

Carapus acus (Brünnich, 1768)
The pearl fish was only found once as it left a captured *Holothuria tubulosa* (Gmelin, 1788) in an aquarium at night. It cannot be concluded with certainty whether this species is common or not.

Family Sphyraenidae

Sphyraena viridensis Cuvier, 1829
The yellow mouth barracuda could be observed regularly in little shoals in the open water beneath the water surface, mainly during summer.

Family Mugilidae

Chelon labrosus (Risso, 1827)
The thicklip grey mullet is very common off Ibiza and occurs in shoals, mostly beneath the water surface next to rocks.

Liza sp.
Representatives of this genus (species could not be verified) are regularly seen in small groups of juveniles.

Oedalechilus labeo (Cuvier, 1829)
The boxlip mullet was found regularly at Portinatx at depths of up to 20 m.

Family Atherinidae

Atherina boyeri Risso, 1810
Boyer's sand smelts occur in large shoals and were observed in shallow water (0.5 to 2 m) over *Cymodocea* meadows in the Cala Boix and in a large cave in the Cala Bassa, where this species was very abundant.

Atherina hepsetus (Linnaeus, 1758)
The Mediterranean sand smelt was mainly observed at night, where it can be found near sandy bottoms at a depth of 5 to 15 m.

Family Scorpaenidae

Scorpaena maderensis Valenciennes, 1833
The Madeira rockfish is regularly found on rocky bottoms under ledges and at entrances of caves, mostly in deep water at between 5 and 20 m.

Scorpaena notata Rafinesque, 1810
The small red scorpionfish is uncommon but can be found on rocky bottoms and in sandy areas in the vicinity of rocks or *Posidonia* at depths of between 4 to 20 m.

Scorpaena porcus Linnaeus, 1758
The black scorpionfish is the most common Scorpaenidae off the island of Ibiza and occurs on rocky bottoms, in boulder fields, and also in *Posidonia* meadows. Range of depth: 0.5 to 20 m.

Scorpaena scrofa Linnaeus, 1758
The red scorpionfish inhabits deeper regions and can only be found beyond a depth of 20 m. It occurs on rocky bottoms as well as in sandy areas next to rocks, caves and ledges.

Family Dactylopteridae

Dactylopterus volitans (Linnaeus, 1758)
The flying gurnard is uncommon off Ibiza but was occasionally found on sandy bottoms in the Cala Llenya and at Portinatx at depths of between 10 and 15 m.

Family Bothidae

Bothus podas podas (Delaroche, 1809)
The wide-eyed flounder is the most common flatfish on sandy bottoms off Ibiza and is found at a range of depth between 3 and 30 m. It was observed near sea grass meadows in association with *Astropecten*.

Family Soleidae

Solea lascaris (Risso, 1810)
The sand sole was only found once on a sandy bottom in the Cala Llenya at a depth of 4 to 5 m.

Family Balistidae

Balistes capriscus (Gmelin, 1789)
The grey triggerfish is not very common off Ibiza and was only detected twice over rocky bottoms in spring 2005, once at the Penyal de s´Aguila as a group of 5 adults at 16 m depth and another time as a juvenile of about 20 cm in the boulder field in the Cala Llenya at a depth of 3 m.

Family Molidae

Mola mola (Linnaeus, 1758)
The ocean sunfish was observed several times in the vicinity of Portinatx, at depths ranging from the surface to approximately 40 m (P.A. Reiserer, personal communication to R.A.P.).

Family Gobiesocidae

Apletodon incognitus Hofrichter & Patzner, 1997
This species is common in the pebble banks of the boulder field in the Cala Llenya at depths of 0.5 to 1 m, but it also occurs in *Posidonia* meadows. In the area of Portinatx young specimens were frequently found in association with the sea urchins *Paracentrotus lividus*, *Arbacia lixula*, and *Sphaerechinus granularis.* They were observed at all depths where sea urchins were found, from 0.2 m down to over 20 m.

Gouania wildenowi (Risso, 1810)
The blunt-snouted clingfish was found only in shallow water (0.2 to 0.5 m) in banks of pebbles around Portinatx. The fish lives within the lower, second layer which consists of pebbles with a diameter of between 1 and 2 cm and spends much of its life concealed.

Lepadogaster candollii Risso, 1810
The Connemarra clingfish is very variable in habitat. It was found in boulder fields, in small cavities in sea grass meadows, under sea urchins, and occasionally in caves within a depth range of 0.5 to 20 m.

Lepadogaster lepadogaster (Bonnaterre, 1788)
The shore clingfish was found on banks of pebbles and in boulder fields at a depth range of 0.3 to 5 m. The animals were normally found on the underside of stones with a diameter of more than 5 cm, where they were attached upside down by their sucker disk. The species was checked against *L. purpurea* (Henriques et al. 2002), which was not found.

Opeatogenys gracilis (Canestrini, 1864)
This species was only found attached to leaves in *Posidonia* meadows. Depth range: 2 to 15 m in the Cala Llenya and around Portinatx.

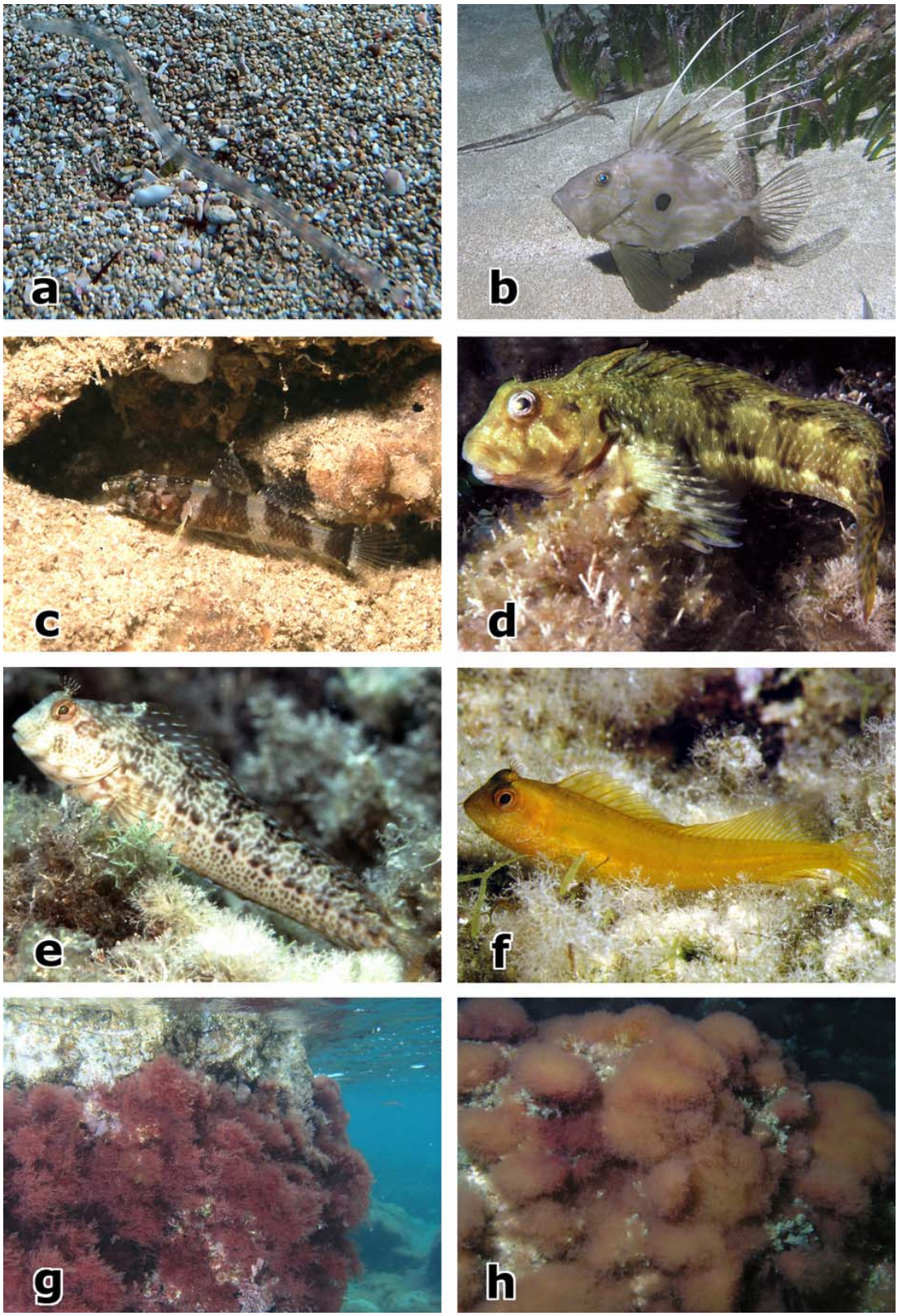

Fig. 3 Fishes and algae around Ibiza. a) juvenile *Ariosoma balearicum* during daytime; b) *Zeus faber* near *Posidinia oceanica*; c) *Didogobius splechtnai* in front of its hole; d) *Scartella cristata,* probably absent from Ibiza since 2000; e) *Parablennius pilicornis* in cross band colouration; f) *P. pilicornis* in yellow colouration; g) *Lophocladia lallemandii* in a shallow area h) *L. lallemandii* at a depth of 20 m at Cala Llenya (note the different colourations).

Discussion

MAYOL ET AL. (2000) described 405 fish species for all the Balearic Islands (Ibiza, Mallorca, Menorca and Formentera). The list also includes off-shore and deep water species which are not in the range of snorkeling or scuba diving. In the present paper the occurrence of 130 fish species is described. Most of these species are benthic (68) or bottom related species (41), with only a few pelagic species (21) recorded. The benthic community is dominated by fishes inhabiting rocky bottoms (47), with Blenniidae and Gobiidae representing more than half of all species. The remainder of the community consists mainly of Scorpaenidae, Gobiesocidae and Tripterygiidae. On sandy bottoms 23 different species occurred, including 6 sit-and-wait predators, hidden in the sand (Trachinidae, Uranoscopidae, Synodontidae), four rays, *Torpedo marmorata, Dasyatis pastinaca* ,*Raja* cf. *miraletus* , *Raja radula* and the eagle ray *Myliobatis aquila*. Like the rays, flatfishes (Bothidae, Solidae) and *Ariosoma balearicum* can also be covered by sand, and the other species inhabit the surface of the sandy bottom (Callionymidae, Dactylopteridae, Mullidae). The bottom related fishes are dominated by 3 families: Labridae, Sparidae and Serranidae. Those species are mainly confined to rocky bottoms and only few of them occur over sand (*Xyrichthyes novacula* and *Lithognathus mormyrus*). Except for a few species, such as the groupers, all three families were abundant both in absolute terms and in number of species. The other fish families which occured (Balistidae, Scianidae, Syngnathidae and Zeidae) were less rich in species and lower in abundance. However, especially cryptic species, such as Syngnathidae in dense *Posidonia* meadows, are not easy to detect by visual census and are often overlooked or underestimated (SMITH 1988). In the pelagic area two main groups can be distinguished: predators such as Sphyraenidae, Moronidae, Carangidae and Belonidae on the one hand, and the planktotroph Atherinidae, Exocoetidae, Centracanthidae and Clupeidae on the other, which are more abundant than the first group and dominate the pelagic area.

Fish species which were not found during the present study. Some species previously described for the island by other authors were not detected by our study. At Portinatx, RIEHL (1978) recorded the pelagic species *Atherina presbyter* (Cuvier, 1817), and in particular benthic species: *Pleuronectes platessa* Linnaeus, 1758, *Raja clavata* Linnaeus, 1758, *Scophthalmus rhombus* (Linnaeus, 1758), *Buglossidium luteum* (Risso, 1810), *Solea solea* (Linnaeus, 1758), *Pomatoschistus microps* (Krøyer, 1838), *P. minutus* (Pallas, 1770) and *Lipophrys pholis* (Linnaeus, 1758). This last species (1978) was declared to be a misidentification (ZANDER pers. comm. in GOLANI ET AL. 2002), but a recent review of the museum material by one of the authors (R.A.P.) confirmed the original determination. See the next chapter for the following other benthic species also reported by Riehl (1978): *Apletodon dentatus* (Facciola, 1887), *Diplecogaster bimaculeatus* (Bonnaterre, 1788), *Ammodytes tobianus* (Linnaeus, 1758) and *Blennius ocellaris* Linnaeus, 1758.
For the marine reserve Freus d'Eivissa, further species are described by Anonymus (2004), all of which are protected and rare species which with one exception appear on the red list for fishes of the Balearic Islands (Mayol ET AL. 2000). In addition, some of those species, such as *Squatina* sp., *Dasyatis centroura* (Mitchill, 1815), *Torpedo torpedo* (Linnaeus, 1758) and *Scyliorhinus stellaris* (Linnaeus, 1758) only occur in deeper areas, or, like *Mustelus* sp., *Sphyrna* sp., and *Prionace glauca* (Linnaeus, 1758), are not detectable using our research techniques. *Umbrina cirrhosa* (Linnaeus, 1758) as well as the Syngnathidae *Hippocampus hippocampus*

(Linnaeus, 1758), *Nerophis ophidion* (Linnaeus, 1758), *Syngnathus abaster* (Risso, 1827) and *Syngnathus acus* (Linnaeus, 1758) are listed in this paper. As already stated, the Syngnathidae in particular are very difficult to detect by visual census because of their perfect camouflage in *Posidonia* meadows. Except for *Syngnathus abaster*, all the Syngnathidae mentioned were also found on the northern coast by RIEHL (1978). ARBONA SAŃCHEZ (2003) also described five further species for the marine reserve in the south of the island. Unfortunately there are no descriptions of the commonness and range of depth of those species. Although species such as *Scyliorhinus canicula* (Linnaeus, 1758) and *Lophius piscatorius* (Linnaeus, 1758) inhabit deeper areas, and *Myctoperca rubra* (Bloch, 1793) appears to be less common, *Pagrus pagrus* (Linnaeus, 1758) and *Chelidonichthys* (=*Trigloporus*) *lastoviza* (Bonnaterre, 1788) also occur in shallower areas.

Possible confusions in literature with other species. Riehl (1978) reported juvenile *Ammodytes tobianus* (Linnaeus, 1758) at Portinatx. This would be the only finding in the Mediterranean Sea. As identification based on juveniles is very uncertain (GOLANI ET AL. 2002) the occurrence of this Atlantic species off Ibiza is doubtful.
In the present study *Blennius ocellaris* was not found in the sea, but it was seen regularly at the fish market at St. Eularia. This supports the idea that this is a deeper water species, living below 30 m (ZANDER 1986). RIEHL's (1978) observation of this species at a water depth of 2 m (no specimen collected) might be a due to confusion with *Parablennius pilicornis*, in which mature males have a very high dorsal fin with a remarkable spot.
Due to the late description of *Apletodon incognitus* by HOFRICHTER & PATZNER (1997) and its similarity to *A. dentatus* and *Diplecogaster bimaculeatus*, the occurrence of these two species off Ibiza can be concluded to be very uncertain.

Symbiosis and other associations. Certain associations between fishes of different species and between fishes and invertebrates in the Mediterranean Sea have been known for several years (e.g. ABEL 1960, THIEL 1970, MOOSLEITNER 1980, MOOSLEITNER 1982, ZANDER 2003).
During our investigations, feeding associations between *Mullus surmuletus*, *Lithognathus mormyrus* (Fig. 2a, 2b) and *Symphodus tinca* were observed. A more detailed investigation – similar to the one by VELTE (2006) - is planned.
PATZNER (1989) observed an association between *Bothus podas podas* and *Astropecten aranciacus* (Fig. 2c) off Ibiza, but we were unable to observe this partnership in recent years because of the disappearance of *A. aranciacus* in this region (MOOSLEITNER & PATZNER 2005).
To our knowledge, no association has previously been described between *Serranus scriba* and *Octopus vulgaris* in the Mediterranean Sea. We found evidence of commensalism (a feeding association), although no direct interactions were observed. A similar relationship between groupers and octopuses has been found in the Red Sea (PATZNER & DEBELIUS 1984) and in the Gulf of California (STRAND 1988).

The behaviour of the only real cleaner fish in the Mediterranean, *Symphodus melanocercus* (Fig. 2d), has been described by several authors (MOOSLEITNER 1980, ZANDER & NIEDER 1997, ZANDER & SÖTJE 2002, PATZNER 2002, PRÖTSCH & PATZNER 2003). A phenomenon which to date has only been observed off Ibiza is that by cleaning adult *Epinephelus marginatus*, *S. melanocercus* does not operate cleaning stations, but accompanies the large fish constantly (PATZNER 2003). It is not known if

this occurs only off Ibiza or also in other parts of the Mediterranean. What is certain is that there are geographical differences in the behaviour of *S. melanocercus* in the Mediterranean Sea (ZANDER & SÖTJE 2002).
The cleaning behaviour of the shrimp *Lysmata seticaudata* in relation to *Muraena helena* was described for the first time at Portinatx (PATZNER 1982) and can be observed regularly.
The association between juveniles of *Trachinus mediterraneus* and *T. trachurus* and the jelly fish *Cotylorhiza tuberculata* is well known in all the Mediterranean area (THIEL 1970). However, a partnership between fishes of this genus and the strongly stinging *Pelagia noctiluca* has not previously been reported. A picture of this association (Fig. 2f) taken by one of the authors (R.A.P.) at Portinatx in around 2 m depth was first published in PATZNER & DEBELIUS (1984); it had been. It most probably shows *T. trachurus*, but this is not quite clear.
The association between *Gobius bucchichi* and the anemone *Anemonia viridis* is a close one in the area around Ibiza (Fig. 2e). It has been shown that is not the case in all the Mediterranean Sea (BRUMMER 1994, VELTE 1994).
The co-occurrence of *Parablennius rouxi* and the similar looking *Gobius vittatus* was also observed off Ibiza, especially around Portinatx. No explanation was found for the existence of mimicry, as suspected by HEYMER & ZANDER (1978). This also applies to the co-occurrence of *Lipophrys nigriceps* and *Tripterygion melanurus* (ZANDER & HEYMER 1976) (Fig. 2g, 2h).
The association between *Carapus acus* and *Holothuria tubulosa* and *Stichopus regalis* (Cuvier, 1817) is well known in the Mediterranean Sea and is most probably a non-parasitic partnership (KLOSS & PFEIFFER 2000).

Decrease in fish species and influence of *Lophocladia* algae. A decrease in the abundance of *Scartella cristata* and *Parablennius pilicornis* has been detected over the course of the last few years. *P. pilicornis* was only rarely found off the northern coast, and *S. cristata* was last found in the year 2000, despite targeted searches for this species. Finally, one specimen was found in the Cala Llenya in March 2007. The thermophile species *S. cristata* showed a northwards migration in the Mediterranean in the 1970s and 80s (CARDONA & ELICES 2001) and was found off the northern Mediterranean Spanish coast in 1988 (Nieder 1988), after being observed in southern Spain as early as 1970 (BATH 1970). Its occurrence in the Balearic Islands was first published by one of the authors (PATZNER 1984) and the species was recorded as not very common. Apart from our own study, there is only one detection of a single specimen for the Balearic Islands, on Menorca in 2001 (CARDONA & ELICES 2001) after 1984. Apart from our own study, it was only detected once/only one specimen was found in the Balearic Islands after 1984, off Menorca in 2001 (CARDONA & ELICES 2001). *P. pilicornis* was also only detected twice off Menorca in the years 1995 and 2000 (CARDONA & ELICES 2000). It seems that neither *S. cristata* nor *P. pilicornis* were very common on the island a priori.
But what caused this decrease in abundance? The occurrence of *S. cristata* in the warmer eastern Mediterranean (DIAMANT ET AL. 1986) and in the Gulf of Mexico and off the coast of Brazil (BATH 1970, ZANDER 1972b) negate the theory that the diminished occurrence of this species is only related to rising water temperatures in the western Mediterranean. Also, the occurrence of the invasive toxic alga *Lophocladia lallemandii* (Montagne) (F. Schmitz), which overgrows rocky bottoms and border areas of *Posidonia* meadows in late summer and autumn, cannot be directly associated with the decrease of *S. cristata*. Even at places in the north of the island where the alga coverage was less dense, the species was detected no more

often in recent years. We are unable at the moment to give probable reasons for the decrease of this species.
Whether or not the red alga has an impact on *S. cristata*, there does seem to be a change in the ichtyofaunistical communities at places of dense coverage (up to 100%). Boudouresque & Verlaque (2002) characterise *Lophocladia lallemandii* as a toxic alga without any predators in the Mediterranean. As in the case of *Caulerpa taxifolia* (M. Vahl) (C. Agardh), the absence of predators enables a rapid spread. The occurrence of this invasive red alga on Ibiza was first described by one of the authors (PATZNER 1998) for the north of the island in 1995. Meanwhile this alga can be found at depths between 0 and 40 m all around the island and also on Formentera, and it shows much denser (up to 100 %) coverage in lentic areas than in areas of frequent disturbance through wave action (Fig. 3g, 3h). The southwest of the island seems to be less covered with *Lophocladia*, which is related to less rocky shores. The impact of *Lophocladia* coverage can be shown by the example of the boulder field at the Cala Llenya. Boulder fields represent a habitat with many macro- and micro-habitats, where many holes and crevices house a lot of invertebrates which represent an important food source for fishes. In addition to the large numbers of invertebrates in the crevices and under stones, the gobies *Gobius bucchichi* and *G. paganellus* were detected in abundance in the spring. In autumn 2006, however, when the whole boulder field with all its crevices was covered by *Lophocladia,* almost no gobies were found. Furthermore, *Anemonia viridis* was not present in autumm at sites where it was very common in spring, and a decrease in agile invertebrates under and between stones was also detected. In the north of the island *Parablennius rouxi* and *Gobius vittatus* as well as several benthic animals were no longer observed in areas of *Lophocladia* (PATZNER 1998).
It would be worth carrying out a comparative study of the infauna of *Lophocladia* and the 'natural' infauna of *Cystoseira*, since a change could have a crucial impact on carnivorous species - as indicated by the absence of several benthic animals in the north of the island, among other things. The future will show what impact *Lophocladia* has on the island of Ibiza and whether it induces further changes in the composition of the ichthyofauna. Due to the complex nature of the issue, recording these kinds of change processes is a major research undertaking. The detailed information gathered in this survey lays the foundation for further comparative studies.

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