

Sexual reproduction in octocorals

Samuel E. Kahng^{1,*}, Yehuda Benayahu², Howard R. Lasker³

¹Hawaii Pacific University, College of Natural Science, Waimanalo, Hawaii 96795, USA

²Department of Zoology, George S. Wise Faculty of Life Sciences, Tel Aviv University, Ramat Aviv, Tel Aviv 69978, Israel

³Department of Geology and Graduate Program in Evolution, Ecology and Behavior, University at Buffalo, Buffalo, New York 14260, USA

*Email: skahng@hpu.edu

Marine Ecology Progress Series 443:265–283 (2011)

Table S1. Octocoral species and data used in the analysis and species assignment to taxonomic groups and to Clades and Subclades (Subclade_{cons}: conservative subclade classification based only on genera in McFadden et. al. 2006)

Group/Family	Genus species	Clade	Subclade	Subclade _{cons}	Location	Latitude	Climate	Symbiont	Sexuality	Sex ratio (F:M)	Mode of reproduction	Max oocyte (um)	Oogenesis (months)	Polyp fecundity	Breeding period	References
Alcyonacea																
Stolonifera																
	Cornulariidae															
	<i>Cervera komaii</i> (<i>Cornularia komaii</i>)	1			Japan	35	subtrop	A	G		E	350			May-June	Suzuki 1971
	<i>Cervera sagamiensis</i> (<i>Cornularia sagamiensis</i>)	1			Japan	35	subtrop	A	G		E	630			Mar-June	Suzuki 1971
	Clavulariidae															
	<i>Carijoa riisei</i>	1	1b	1c	Hawaii	21	trop	A	G+	1:1	S	550	<=12	7.4	continuous	Kahng et al. 2008; Kahng 2006

<i>Carijoa riisei</i> (<i>Telesto riisei</i>)	1	1b	1c	Puerto Rico	18	trop	A	G+	1:1	?			continuous	Bardales 1981	
<i>Clavularia crassa</i>	1		1h	Morocco (Mediterranean)	35	temp	A	?			E			Benayahu & Loya 1983; Benayahu 1989	
<i>Clavularia inflata</i>	1	1n	1j	GBR, Philippines	18	trop	Z	G			E	105 0	Oct-Nov	Alino & Coll 1989; Bermas et al. 1992	
<i>Clavularia koellikeri</i>	1	1n	1j	GBR	11- 12	trop	Z	?			B			Bastidas et al 2002	
Alcyoniina															
Alcyoniidae															
<i>Acrophytum claviger</i>	1			South Africa	27	subtrop	?	G			?	200 0		Hickson 1900	
<i>Alcyonium acaule</i>	1	1i	1g	Spain, France (NW Mediterranean)	42	temp	A	G			E		June-July	Hartnoll 1975; Garrabou 1999; McFadden 2001; E Sala, pers. comm.	
<i>Alcyonium coralloides</i>	1	1i	1g	NW Mediterranean, NE Atlantic	43	temp	A	M			B			McFadden 1999; McFadden 2001; Groot & Weinberg 1982	
<i>Alcyonium digitatum</i>	1	1i	1g	Irish Sea, France (Atlantic)	54	temp	A	G+			S	600	12	Dec-Jan	Hartnoll 1975, 1977; McFadden 2001
<i>Alcyonium glomeratum</i>	1	1i	1g	France (Atlantic & Mediterranean)	48- 54	temp	A	G			S				McFadden 2001
<i>Alcyonium hibernicum</i>	1	1i	1g	Irish Sea, France (Atlantic)	54	temp	A	P	1:0		B	640	10- 11	Aug-Sept	Hartnoll 1977; McFadden 1999
<i>Alcyonium pacificum</i>	1	1i	1g	Aleutian Islands	52	temp	A	G			B	340		July-Aug*	McFadden et al 2003
<i>Alcyonium palmatum</i>	1	1i	1g	France (Mediterranean)	43	temp	A	G			S			Aug-Oct	Hartnoll 1975; McFadden 2001
<i>Alcyonium sidereum</i>	1	1i	1g	Massachusetts	42	temp	A	H			B	700		Aug	Sebens 1983a, b, c
<i>Alcyonium sp. A</i>	1	1i	1g	Irish Sea	54	temp	A	H			B				McFadden 2001
<i>Alcyonium sp. A3</i>	1	1i	1g	Portugal	37	temp	A	?			B				McFadden 1999
<i>Alcyonium sp. C</i>	1	1i	1g	San Juan Islands	48	temp	A	?			B				McFadden 2001
<i>Alcyonium sp. M2</i>	1	1i	1g	Mediterranean	43	temp	A	?			?				McFadden 1999
<i>Anthomastus grandiflorus</i>				Newfoundland and Labrador	43- 62	cold	A	G	4:1		B	110 0	<12	Sep-Oct	Mercier & Hamel 2011
<i>Anthomastus ritteri</i>	3	3	3	California, Baja	37	cold	A	G			B	550	5.3	continuous	Cordes et al 2001

<i>Cladiella pachyclados</i>	1	1h	1d	GBR	23	trop	Z	G	S	450							Benayahu et al 1990; Benayahu & Loya 1986; Benayahu 1997
<i>Cladiella pachyclados</i> (<i>Alcyonium pachyclados</i>)	1	1h	1d	South Africa	27	subtrop	Z	G	?								Hickson 1900
<i>Cladiella</i> (cf.) <i>prattae</i>	1	1h	1d	GBR	19	trop	Z	G	S	700			Oct-Nov				Alino & Coll 1989
<i>Cladiella tuberosa</i>	1	1h	1d	Thailand	12	trop	Z	G	1:1	?	625		July-Sept				Nobchinwong & Yeemin 2004
<i>Discophyton rudyi</i> (<i>Alcyonium rudyi</i>)	1		1c	British Columbia to California	48	temp	A	G+	B	740			Aug-Sept				McFadden 1991; McFadden & Hochberg 2003
<i>Klyxum aspiculatum</i> (<i>Alcyonium aspiculatum</i>)	1	1h	1d	GBR	18	trop	Z	G	S								Babcock et al. 1986; Alino & Coll 1989
<i>Klyxum molle</i> (<i>Alcyonium molle</i>)	1	1h	1d	GBR	18	trop	Z	G	S	700							Alino & Coll 1989
<i>Lobophytum compactum</i>	1	1c	1g	GBR	18	trop	Z	G	S	650		23	Oct-Nov				Bowden et al 1985 Babcock et al. 1986; Alino & Coll 1989
<i>Lobophytum crassum</i>	1	1c	1g	GBR	19	trop	Z	G	S	792	m	4.2	Nov-May				Bowden et al 1985; Alino & Coll 1989
<i>Lobophytum crassum</i>	1	1c	1g	Okinawa	26	trop	Z	G	S	573	24	36	June				Yamazato et al 1981
<i>Lobophytum depressum</i>	1	1c	1g	South Africa	27	subtrop	Z	G	S								Benayahu 1997
<i>Lobophytum hirsutum</i>	1	1c	1g	GBR	18	trop	Z	G	S		m		Nov				Babcock et al. 1986; Alino & Coll 1989
<i>Lobophytum microlobulatum</i>	1	1c	1g	GBR	18	trop	Z	G	S	600			Nov				Babcock et al. 1986; Alino & Coll 1989
<i>Lobophytum pauciflorum</i>	1	1c	1g	GBR	18	trop	Z	G	S	690	m	11.5	Oct-Feb				Alino & Coll 1989
<i>Lobophytum pauciflorum</i>	1	1c	1g	Taiwan	22	trop	Z	G	1:1	S	870	12	16	July-Sept			Fan et al. 2005; Chou 2002
<i>Lobophytum planum</i>	1	1c	1g	GBR	18	trop	Z	G	S	600	m		Oct-Nov				Alino & Coll 1989
<i>Lobophytum sarcophytoides</i>	1	1c	1g	Taiwan	18*	trop	Z	G	S								Benayahu et al 1990; Benayahu 1997
<i>Lobophytum sp.</i>	1	1c	1g	Hong Kong	22	trop	Z	G	1:0	S		m	July				Yeung & Ang 2008
<i>Malacacanthus capensis</i> (<i>Heteroxenia capensis</i>)	1			South Africa	27	subtrop	Z	G	?								Hickson 1900; Gohar 1940a, b
<i>Rhytisma fulvum fulvum</i> (<i>Parerythropodium fulvum fulvum</i>)	1	1b	1b	Red Sea, Philippines	29	trop	A	G	1:1	E	700	10-11	18-24	June- Aug			Benayahu & Loya 1983; Bermas et al. 1992
<i>Sarcophyton crassocaule</i>	1	1c	1g	Taiwan	22	trop	Z	G	4:3	S	915	20	23	April-June			Benayahu et al 1990; Chou 2002
<i>Sarcophyton</i> (cf.) <i>ehrenbergi</i>	1	1c	1g	GBR	18	trop	Z	G	S	710	m	4.2	Oct-Nov				Alino & Coll 1989
<i>Sarcophyton glaucum</i>	1	1c	1g	GBR	18	trop	Z	G	S	600	m	36	Oct-Nov				Alino & Coll 1989

<i>Sarcophyton glaucum</i>	1	1c	1g	Red Sea	29	subtrop	Z	G	1:1	S	750	22-23	July	Benayahu & Loya 1986	
<i>Sarcophyton glaucum</i>	1	1c	1g	South Africa	27	subtrop	Z	M	1:1	S	800	16-18	Feb-March	Schleyer et al 2004	
<i>Sarcophyton trocheliphorum</i>	1	1c	1g	Taiwan	22	trop	Z	G	1:0	S	763	21	June-Aug	Chou 2002	
<i>Sarcophyton trocheliphorum</i>	1	1c	1g	GBR	23	trop	Z	G		S			11.5	Benayahu et al 1990; Benayahu 1997	
<i>Sarcophyton sp.</i>	1	1c	1g	GBR	18	trop	Z	G		S	600		16	Oct-Nov	Babcock et al. 1986; Alino & Coll 1989
<i>Sinularia conferta</i>	1	1c	1g	GBR	19	trop	Z	G		S	825	m		Oct-Nov	Alino & Coll 1989
<i>Sinularia cruciata</i>	1	1c	1g	GBR	18	trop	Z	G		S	790	m		Oct-Nov	Alino & Coll 1989
<i>Sinularia deformis</i>	1	1c	1g	GBR	18	trop	Z	G		S					Babcock et al. 1986; Alino & Coll 1989
<i>Sinularia dura</i>	1	1c	1g	South Africa	27	subtrop	Z	G		S	500				Benayahu et al 1990; Benayahu & Loya 1986; Benayahu 1997
<i>Sinularia exilis</i>	1	1c	1g	Taiwan	22	trop	Z	H		S	800	m	15.6	May-June	Wu 1994
<i>Sinularia flexibilis</i>	1	1c	1g	GBR	9-20	trop	Z	?		S					Bastidas et al 2001
<i>Sinularia gyrosa</i>	1	1c	1g	South Africa	27	subtrop	Z	G		S					Benayahu et al 1990; Benayahu 1997
<i>Sinularia humesi</i>	1	1c	1g	Red Sea	29	subtrop	Z	G		S	980	18-24			Benayahu et al 1990
<i>Sinularia leptoclados</i>	1	1c	1g	Red Sea	29	subtrop	Z	G		S	1000	18-24			Benayahu et al 1990
<i>Sinularia lochmodes</i>	1	1c	1g	GBR	19	trop	Z	G		S	800	m		Oct-Nov	Alino & Coll 1989
<i>Sinularia mayi</i>	1	1c	1g	Red Sea	29	subtrop	Z	G		S	1150	18-24			Benayahu et al 1990
<i>Sinularia nanolobata</i>	1	1c	1g	Taiwan	22	trop	Z	H		S	800	m	16.2	July-Aug	Wu 1994
<i>Sinularia polydactyla</i>	1	1c	1g	GBR, Guam	18	trop	Z	G	2:1	S	805	12		April-June	Alino & Coll 1989; Slattery et al 1999
<i>Sinularia rigida</i>	1	1c	1g	GBR	19	trop	Z	G		S	800	m		Oct-Nov	Alino & Coll 1989
<i>Sinularia scabra</i>	1	1c	1g	Taiwan	22	trop	Z	H		S	800	m	66	May-June	Wu 1994
<i>Thrombophyton coronatum</i> (<i>Alcyonium</i> sp. D)	1		1e	California	33	temp	A	G		B				Apr-May	McFadden & Hochberg 2003; McFadden 2001
<i>Thrombophyton trachydermum</i> (<i>Alcyonium</i> sp. B)	1		1e	British Columbia, California	48	temp	A	G		?	670			Aug-Sept	McFadden & Hochberg 2003; McFadden 2001
Nephtheidae															
<i>Capnella gaboensis</i>	1	1e	1c	New South Wales (SE Australia)	33	temp	Z	G+	1:1.3	E		12	10	Oct-Dec*	Farrant 1985, 1986

	<i>Dendronephthya castanea</i>	1	1e	1e	Korea	33	temp	A	G	1.6:1	B	490			July-Sept	Hwang & Soong 2008
	<i>Dendronephthya gigantea</i>	1	1e	1c	Korea	33	temp	A	G	2:1	B	500	12	8	July-Sept	Hwang & Soong 2007
	<i>Dendronephthya hemprichi</i>	1	1e	1c	Red Sea	29	subtrop	A	G	3:2	S	500	m		continuous	Dahan & Benayahu 1997a, b, 1998
	<i>Dendronephthya sinaiensis</i>	1	1e	1c	Red Sea	29*	subtrop	A	G		S					Benayahu 1997
	<i>Dendronephthya spinulosa</i>	1	1e	1c	Korea	33	temp	A	G	1.1:1	S	449	<=12		Aug-Sept	Hwang & Soong 2008
	<i>Dendronephthya suenoni</i>	1	1e	1c	Korea	33	temp	A	G	2:1	S	354	12		Sept-Oct	Choi & Soong 2007
	<i>Drifa glomerata</i>	1			Newfoundland	50	cold	A	G	1:0	B		m	3.4	continuous	Sun et al. 2010a, b
	<i>Drifa sp.</i>				Newfoundland	50	cold	A	H		B					Sun et al. 2010a, b
	<i>Gersemia rubiformis</i>	1	1i	1g	Bay of Fundy (SE Canada)	42-45	cold	A	G		B	250				Sebens 1983b; Henry et al 2003
	<i>Litophyton arboreum</i>	1		1c	Red Sea	29	subtrop	Z	G		B	1150	18-24			Benayahu et al 1990; Ben-David-Zaslow & Benayahu 1998
	<i>Nephtea sp.</i>	1	1e	1c	Red Sea	29	subtrop	Z	G		B	650				Benayahu 1997; Ben-David-Zaslow & Benayahu 1998
	<i>Paralemnalia thyrsoidea</i>	1	1b	1b	Red Sea	29	subtrop	Z	G		B					Benayahu 1997
	<i>Stereonephthya cundabiluensis</i>	1	1e	1c	Red Sea	29	subtrop	A	G		B	650				Benayahu 1997; Benayahu pers pers. comm..
	<i>Scleronephthya gracillimum</i>	1			Korea	33	temp	A	G	1.1:1	S	447	<=12		Sept	Hwang & Soong 2008
Xeniidae																
	<i>Anthelia fishelsoni</i>	1	1e	1b	Red Sea	28	subtrop	Z	G		?					Benayahu 1991
	<i>Anthelia formosa</i>	1	1e	1b	Japan	22	trop	Z	?		?	700				Benayahu & Loya 1986
	<i>Anthelia glauca</i>	1	1e	1b	Red Sea	27-29	subtrop	Z	G		B			12		Benayahu 1991
	<i>Anthelia glauca</i>	1	1e	1b	South Africa, Red Sea	27	subtrop	Z	G+	1:1	B	787	8-15	49	Jan-April/May	Gohar 1940a, b; Kruger et al 1998; Benayahu & Schleyer 1998
	<i>Cespitularia exigua</i>	1	1b	1b	Red Sea	27-29	subtrop	Z	G		?					Benayahu 1991
	<i>Efflatounaria sp.</i>	1		1b	GBR, Philippines	18	trop	Z	G		E	1000			Dec	Dinesen 1985; Alino & Coll 1989; Bermas et al. 1992
	<i>Heteroxenia coheni</i>	1		1b	Red Sea	27-29	subtrop	Z	H		B					Benayahu 1991
	<i>Heteroxenia elizabethae</i>	1		1b	Red Sea	27	subtrop	Z	H		B					Gohar 1940a, b
	<i>Heteroxenia elizabethae</i>	1		1b	GBR	23	trop	Z	G		B	750				Hickson 1931; Benayahu et al 1990

<i>Heteroxenia fuscescens</i>	1		1b	Red Sea	28	subtrop	Z	H		B	800	m		Mar-Sept*	Gohar 1940a, b; Gohar & Roushdy 1961; Benayahu et al. 1989; Achituv & Benayahu 1990; Benayahu 1991; Ben- David-Zaslow & Benayahu 1996, 1999
<i>Heteroxenia ghardagensis</i>	1		1b	Red Sea	28	subtrop	Z	G+		B				May-June	Gohar 1940a, b
<i>Heteroxenia sp.</i>	1		1b	GBR	18	trop	Z	G		B	105			Oct-Nov	Alino & Coll 1989
<i>Ovabunda biseriata</i> (<i>Xenia biseriata</i>)	1	1b	1b	Red Sea	28	subtrop	Z	G		B					Benayahu et al 1990; Benayahu 1991
<i>Ovabunda farauensis</i> (<i>Xenia farauensis</i>)	1	1b	1b	Red Sea	28	subtrop	Z	G		B					Benayahu et al 1990; Benayahu 1991
<i>Ovabunda impulsatilla</i> (<i>Xenia impulsatilla</i>)	1	1b	1b	Red Sea	28	subtrop	Z	G		B					Benayahu et al 1990; Benayahu 1991
<i>Ovabunda macrospiculata</i> (<i>Xenia macrospiculata</i>)	1	1b	1b	Red Sea	29	subtrop	Z	G+	2:3	B	500	12	>100	May-Sept	Benayahu & Loya 1984a, b, c
<i>Ovabunda obscuronata</i> (<i>Xenia obscuronata</i>)	1	1b	1b	Red Sea	28	subtrop	Z	G		B					Benayahu et al 1990; Benayahu 1991
<i>Sarcothelia edmondsoni</i> (<i>Anthelia edmondsoni</i>)	1		1b	Hawaii	21	trop	Z	G	1:1.4	E	400			continuous	Davis 1977
<i>Sympodium caeruleum</i>	1		1b	Red Sea	28	subtrop	Z	G		B				8-12	Gohar 1940a, b; Benayahu et al 1990; Benayahu 1991
<i>Xenia blumi</i>	1	1b	1b	Red Sea	27	subtrop	Z	G		B				May-June	Gohar 1940a, b
<i>Xenia garciae</i>	1	1b	1b	Red Sea	28	subtrop	Z	G		B					Benayahu et al 1990; Benayahu 1991
<i>Xenia grasshoffi</i>	1	1b	1b	Red Sea	28	subtrop	Z	H		?					Benayahu et al 1990; Benayahu 1991
<i>Xenia hicksoni</i>	1	1b	1b	Red Sea	27	subtrop	Z	G		B				May-June	Gohar 1940a, b
<i>Xenia kikenthali</i>	1	1b	1b	Red Sea	28	subtrop	Z	G		?					Benayahu 1991
<i>Xenia lillieae</i>	1	1b	1b	Red Sea	28	subtrop	Z	G		?					Benayahu 1991
<i>Xenia membranacea</i>	1	1b	1b	Red Sea	28	subtrop	Z	G		B					Benayahu et al 1990; Benayahu 1991
<i>Xenia novaebritanniae</i>	1	1b	1b	Red Sea	28	subtrop	Z	H		B					Benayahu et al 1990; Benayahu 1991
<i>Xenia umbellata</i>	1	1b	1b	Red Sea	29	subtrop	Z	G		B	400	m		May-Nov	Gohar 1940a, b; Benayahu et al 1988; Benayahu et al 1990; Benayahu 1991
<i>Xenia viridis</i>	1	1b	1b	Red Sea	27	subtrop	Z	H		?					Gohar 1940a, b

	<i>Xenia sp. 1</i>	1	1b	1b	GBR	18	trop	Z	G	B	950			Oct-Nov	Alino & Coll 1989	
	<i>Xenia sp. 2</i>	1	1b	1b	GBR	18	trop	Z	G	B	950			Oct-Nov	Alino & Coll 1989	
Scleraxonia																
	Briareidae															
	<i>Briareum asbestinum</i>			4	Jamaica, Puerto Rico, E Panama	9	trop	Z	G	1:2.2	E	900	11-12	2.3	June-July	Kinzie 1970; Bardales 1981; Brazeau 1989; Brazeau & Lasker 1989; Brazeau & Lakser 1990; Brazeau 1992
	<i>Briareum hamrum</i> (<i>Clavularia hamra</i>)	1	1n	1j	Red Sea	29	subtrop	Z	G		E	750	11	14-26	Aug-Sept	Benayahu 1989
	<i>Briareum stechei</i>			4	GBR	18	trop	Z	G		E	725			Oct-Nov	Alino & Coll 1989
	<i>Pachyclavularia violacea</i>	1			GBR	18	trop	Z	G		E	1000			Oct-Nov	Alino & Coll 1989
	Anthothelidae															
	<i>Tripalea clavaria</i>	1			Argentina	38	temp	A	G	1.8:1	B	700	>12	8	April-May	Excoffon et al 2004
	Subergorgiidae															
	<i>Subergorgia suberosa</i>	1			Taiwan	22	trop	A	G	1:1	S	380*	11	1.4	Oct	Chang 2007
	<i>Subergorgia mollis</i>	1			Taiwan	22	trop	?	G	F<M	S	510*	14	1.1	Sept	Chang 2007
	Coralliidae															
	<i>Corallium lauuense</i>	3	3	3	Hawaii	18-23	cold	A	G		S	660	m			Waller & Baco 2007
	<i>Corallium rubrum</i>	3	3	3	Spain, France, Italy (NW Mediterranean)	43	temp	A	G	1:1	B	900	24	3-6	July-Aug	Santangelo et al. 2003; Santangelo et al. 2004; Torrents et al 2005; Tsounis et al. 2006; 2003; Santangelo et al. 2007
	<i>Corallium secundum</i>	3	3	3	Hawaii	18-23	cold	A	G		S	600	m		June-July	Grigg 1976; Waller & Baco 2007
	Melithaeidae															
	<i>Acabaria biserialis</i>	1		1i	Red Sea	28	subtrop	A	G	4:3	B	240	<=12		March-July	Ben-Yosef & Benayahu 1999
	<i>Acabaria erythraea</i>	1		1i	Israel (E Mediterranean)	32	subtrop	A	H		B	120		10-25	July-Sept	Fine et al 2005; Fine pers. comm.
	<i>Melithaea flabellifera</i>	1		1i	Japan	34	subtrop	A	?		B		<=12	10-29	May-	Matsumoto 1997, 2004

Holaxonia

Plexauridae

<i>Astrogorgia dimorpha</i>	1			Korea	33	temp	A	G	1.86: 1	S	540	>12		Sept-Oct	Seo et al 2008
<i>Bebryce indica</i>	1			Taiwan	22	trop	Z	G	1:1	?	440 *	m		Mar-Sept*	Chang 2007
<i>Calicogorgia granuloso</i>	1	1g		Korea	33	temp	A	G	1.5:1	S	750	<=12		Mar, Aug, Sep	Cho & Soong 2008
<i>Eunicea calyculata</i>	1	1a	1a	Venezuela	11- 12	trop	Z	?		S				Aug	Bastidas et al. 2005
<i>Eunicea clavigera</i>	1	1a	1a	Jamaica	18	trop	Z	G							Kinzie 1970
<i>Eunicea flexuosa</i> (<i>Plexaura flexuosa</i>)	1	1a	1a	E Panama, Florida, Venezuela, Bermuda	9-25	trop	Z	G	1:1	S	667	7-8	1.5	June-Sept	Beiring & Lasker 2000; Fitzsimmons- Sosa et al. 2004; Bastidas et al. 2005; Pakes & Woollacott 2008
<i>Eunicea tourneforti</i>	1	1a	1a	Venezuela	11- 12	trop	Z	?		S				Sept	Bastidas et al. 2005
<i>Eunicella cavolini</i>	1		1a	Mediterranean	40	temp	A	?							Gohar 1940a, b
<i>Eunicella singularis</i> (<i>Eunicella stricta</i>)	1		1a	Spain (NW Mediterranean)	37- 43	temp	Z	G	1:1	B	900	13- 17	1.2	May-July	Brazeau & Lasker 1989; Ben Yosef et al 1999 as <i>E. stricta</i> ; Gori et al 2007; Ribes et al 2007
<i>Muricea atlantica</i>	1	1a	1a	Florida	25	trop	Z	G	1:1	?		10- 12	2	June-Sept*	Fitzsimmon-Sosa et al. 2004
<i>Muricea californica</i>	1	1a	1a	California	33	temp	Z	G	1:1	B	800		1.6	Sept-Feb	Grigg 1970; Grigg 1977; Grigg 1979
<i>Muricea fruticosa</i>	1	1a	1a	California	33	temp	A	G	1:1	B	700		3.8	Sept-Feb	Grigg 1970; Grigg 1977; Grigg 1979
<i>Muriceopsis flavida</i>	1	1h	1d	Jamaica, Puerto Rico, Florida	25	trop	Z	G				4	1.5	Dec-Feb*	Kinzie 1970; Bardales 1981; Fitzsimmons- Sosa et al. 2004
<i>Paramuricea clavata</i>	1		1e	Spain (NW Mediterranean)	37- 43	temp	A	G+	1:1	E	550	13- 18	13	May-July	Coma et al. 1995a, b; Gori et al 2007; Linares et al 2008a, b
<i>Paramuricea placomus</i>	1		1e	Gulf of Maine (NW Atlantic)	38- 40	cold	A	H		?	327				Simpson et al. 2005
<i>Plexaura homomalla</i>	1	1a	1a	Jamaica, Florida, Venezuela	25	trop	Z	G	1:1	S	640	18	2	May-Aug	Kinzie 1970; Goldberg & Hamilton 1974; Fitzsimmons- Sosa et al. 2004; Bastidas et al. 2005

	<i>Plexaura kuna</i> (<i>Plexaura</i> A)	1	1a	1a	Jamaica, E Panama,	9	trop	Z	G	1:0	S	800	12- 13	1.9	May-Aug	Lasker et al 1996; Lasker & Kim 1996; Coma & Lasker 1997; Brazeau & Lasker 1989 as <i>Plexaura</i> A; Kinzie 1970 as P. A
	<i>Plexaurella nutans</i>	1	1d	1e	E Panama	25	trop	Z	?		S	?			July	H. Lasker pers. comm.
	<i>Plexaurella</i> sp.	1	1d	1e	Venezuela	10- 11	trop	Z	?		S				Sept	Bastidas et al. 2005
	Family assignment uncertain															
	<i>Pseudoplexaura porosa</i>	1	1a	1a	E Panama	9	trop	Z	G		S	825	<=12	4.33	June-Sept	Lasker et al 1996; Kapela & Lasker 1999
Gorgoniidae																
	<i>Gorgonia ventalina</i>	1	1d	1f	Florida, Puerto Rico	25	trop	Z	G	3:2	S		m	1.7	May-Sept*	Fitzsimmons-Sosa et al. 2004; Flynn 2008
	<i>Leptogorgia capensis</i>	1	1d	1f	South Africa	27	subtrop	?	?		B					Hickson 1900; Gohar 1940a, b
	<i>Leptogorgia virgulata</i>	1	1d	1f	Florida	30	trop	A	G		S	600			April-Oct	Adams 1980; Gotelli 1985, 1988, 1991
	<i>Phyllogorgia dilatata</i>	1	1d	1f	Brazil	17	trop	Z	G	2.6:1	B	470	m			Ferreira (2009)
	<i>Pseudopterogorgia americana</i>	1	1d	1f	Puerto Rico, Florida, Venezuela	25	trop	Z	G	2:1	S	640	7-9	1	Aug-Dec	Buchanan 1979; Fitzsimmons-Sosa et al. 2004; Bastidas et al. 2005
	<i>Pseudopterogorgia acerosa</i>	1	1d	1f	Puerto Rico	25	trop	Z	?		S				Aug-Oct	Yoshioka 1979
	<i>Pseudopterogorgia bipinnata</i>	1	1d	1f	Jamaica, E Panama	18	trop	Z	G		E			7	Dec-Feb	Kinzie 1970; Kinzie 1974; Lasker pers. comm.
	<i>Pseudopterogorgia elisabethae</i>	1	1d	1f	Jamaica, Bahamas	24- 26	trop	Z	G		E	580	10	3	Nov-Dec, Feb	Kinzie 1970; Gutierrez-Rodriguez & Lasker 2004
Calcaxonia																
Ellisellidae																
	<i>Ellisella robusta</i>	2		2a	Taiwan	22	trop	A	G	1:1	S	400 *	12	3.2	Oct	Chang 2007
	<i>Junceella elongate</i> (<i>Junceella elongata</i> as Gorgonellidae; <i>Gorgonia elongata</i> , <i>Ellisella elongate</i>)	2		2a	South Africa	27	subtrop	A	G		?	100 0				Hickson 1900
	<i>Junceella fragilis</i>	2		2a	Taiwan	21	trop	Z	G	1:0	S	275	m		Aug	Vermeire 1994
Chrysogorgiidae																
	<i>Metallogorgia melanotrichos</i>	2	2b	2a	Gulf of Maine (NW Atlantic)	38- 40	cold	A	G		?	367	m			Simpson et al. 2005

Primnoidae

<i>Ainigmaptilon antarcticum</i>	2		2a	Antarctica	71	cold	A	G	1:1	?	900	18-24	3	Aug-Sept*	Orejas et al 2002
<i>Dasystenella acanthina</i>	2		2a	Antarctica	71	cold	A	G		?	1150	>12	1.2		Orejas et al 2006
<i>Fannyella rossii</i>	2	2a	2a	Antarctica	71	cold	A	G		B	460		1.5		Orejas et al 2002; Orejas et al. 2006
<i>Fannyella spinosa</i>	2		2a	Antarctica	71	cold	A	G		B	300		1.4		Orejas et al 2006
<i>Peltastisis sp.</i>	2		2a	Antarctica	70*	cold	A	?		B					Brito 1993
<i>Plumarella delicatissima</i>	2		2a	Antarctica	70*	cold	A	?		B					Brito 1993
<i>Primnoa flabellum</i>	2		2a	Antarctica	70*	cold	A	G		?					Brito 1993
<i>Primnoa resedaeformis</i>	2		2a	Antarctica	70*	cold	A	H		B					Goldberg & Hamilton 1974; Brito 1993
<i>Primnoa resedaeformis</i>				Newfoundland and Labrador	55-61	cold	A	?	1:0	S	1000	m	6-10	continuous	Mercier & Hamel 2011
<i>Primnoella sp.</i>	2		2a	Antarctica	70*	cold	A	G		?					Brito 1993
<i>Thouarella variabilis</i>	2		2a	Antarctica	71	cold	A	G+		B	580	m	1	Jul-Aug*	Brito 1993
<i>Thouarella sp.</i>	2		2a	Antarctica	71	cold	A	G		B	525	>12	1.1		Orejas et al 2006

Isididae

Isididae				Nova Scotia, Flemish Cap	44-47	cold	A	G		?					Beazley & Kenchington 2010
				Newfoundland and Labrador	44	cold	A	?	1:0	S	700	<12	0-10	July-Sep*	Mercier & Hamel 2011
<i>Mopsea elongata</i>	2		2a	Antarctica	70*	cold	A	?		B	650				Brito 1993
<i>Mopsea gracilis</i>	2	2b	2a	Antarctica	70*	cold	A	?		B					Brito 1993

Pennatulacea

Veretillidae

<i>Cavernularia clavata</i>	2		2b	Taiwan	23	trop	A	G		?					Soong 2005; Soong pers comm
<i>Cavernularia elegans</i> formerly in Virgularidae	2		2b	South Africa	27	subtrop	A	G		?	500				Hickson 1900
<i>Cavernularia obesa</i>	2		2b	Taiwan	23	trop	A	G		?					Soong 2005; Soong pers comm
<i>Cavernularia obesa</i> formerly in Virgularidae	2		2b	South Africa	27	subtrop	A	G		?					Hickson 1900

Renillidae

<i>Renilla koellikeri</i>	2	2a	2b	California	34	temp	A	G		S	400		8	May-July	Satterlie & Case 1979; Tremblay et al 2004
---------------------------	---	----	----	------------	----	------	---	---	--	---	-----	--	---	----------	--

	<i>Renilla reniformis</i>	2	2a	2b	NW Atlantic	35	temp	A	G		S	350	m		May-July	Wilson 1883	
Kophobelemnidae																	
	<i>Kophobelemnion stelliferum</i>	2	2a	2b	Porcupine Seabight (NE Atlantic)	49-52	cold	A	G	1:1	?	800	m			Rice et al 1992	
Anthoptilidae																	
	<i>Anthoptilum murrayi</i>				Brazil	13-22	cold	A	G	1:1	S	1200	m	47.6	continuous	Pires et al 2009	
Funiculinidae																	
	<i>Funiculina quadrangularis</i>	1			W Scotland	56	cold	A	G	1:1	S	900	>12		Oct-Jan	Edwards & Moore 2008	
Umbellulidae																	
	<i>Umbellula encrinus</i>	1	2a	2a	NE Atlantic	60-70	cold	A	?		B					Tyler et al. 1995	
	<i>Umbellula lindahli</i>	2	2a	2b	Porcupine Seabight (NE Atlantic)	49-52	cold	A	G		S	800				Tyler et al 1995	
Virgulariidae																	
	<i>Virgularia juncea</i>	2		2b	Taiwan	23	trop	Z	G		S	275	12-14		Aug-Sept	Soong 2005	
	<i>Virgularia mirabilis</i>	2		2b	NE Atlantic	55*	temp	A	?		S					Brito 1993	
Pennatulidae																	
	<i>Prilosarcus guerneyi</i>	2		2b	Washington (NE Pacific)	47	temp	A	G		S	600			March	Chia & Crawford 1973	
	<i>Pennatula aculeata</i>	2	2a	2b	Gulf of Maine (NW Atlantic)	43	cold	A	G		S	880	m		continuous	Eckelbarger et al 1998	
	<i>Pennatula phosphorea</i>	1	2a	2a	W Scotland	56	temp	A	G	1:1	S	600	>12		July-Aug	Edwards & Moore 2008	
	<i>Pteroeides sp. (A)</i>	1	2a	2a	Taiwan	23	trop	A	G		?					Soong 2005; Soong pers comm	
	<i>Pteroeides sp. (B)</i>	1	2a	2b	New Zealand	45	temp	A	G	1:1	S	550	>12		Jul-Aug*	Edwards & Moore 2008	
Helioporacea																	
Helioporidae																	
	<i>Heliopora coerulea</i>	2	2a	2b	GBR	18	trop	Z	G	F>M	E	920	12	2	Dec-Jan	Babcock 1990	
	<i>Heliopora coerulea</i>	2	2a	2b	Japan	24	subtrop	Z	G	1:1	E			1	June-July	Harii & Kayanne 2002; Harii et al. 2002, Harii et al 2003	

Abbreviations/Notes

G	gonochoric
G+	gonochoric with rare hermaphroditic colonies
H	hermaphroditic
M	mixed sexuality
P	parthenogenetic
S	broadcast spawner
B	internal brooder
E	external surface brooder
Z	zooxanthellate
A	azooxanthellate
m	multiple overlapping oogenic cycles
?	unknown
*	inferred data
()	synonyms denoted in parentheses

LITERATURE CITED

- Achituv Y, Benayahu Y (1990) Polyp dimorphism and functional, sequential hermaphroditism in the soft coral *Heteroxenia fuscescens* (Octocorallia). *Mar Ecol Prog Ser* 64:263–269
- Adams RO (1980) Investigations of color, morphology and development of the sea whip, *Leptogorgia virgulata*, (Lamarck) Cnidaria: Octocorallia: Gorgonacea). Ph.D. thesis, Florida State University, p 86
- Alino PM, Coll JC (1989) Observations of the synchronized mass spawning and post settlement activity of octocorals on the Great Barrier Reef, Australia: Biological aspects. *Bull Mar Sci* 45:697–707
- Babcock RC (1990) Reproduction and development of the blue coral *Heliopora coerulea* (Alcyonaria: Coenothecalia). *Mar Biol* 104:475–481
- Babcock RC, Bull GD, Harrison PL, Heyward AJ, Oliver JK, Wallace CC, Willis BL (1986) Synchronous spawning of 105 scleractinian coral species on the Great Barrier Reef. *Mar Biol* 90:379–394
- Baird AH, Guest JR, Willis BL (2009) Systematic and biogeographical patterns in the reproductive biology of scleractinian corals. *Annu Rev Ecol Evol Syst* 40:551–571
- Bardales AT (1981) Reproductive patterns of three species of octocorals (families Telestidae, Briareidae, Plexauridae) in the vicinity of La Parguera, Puerto Rico. Masters of Science thesis, University of Puerto Rico, p85
- Bastidas C, Benzie JAH, Uthicke S, Fabricius KE (2001) Genetic differentiation among populations of a broadcast spawning soft coral, *Sinularia flexibilis*, on the Great Barrier Reef *Marine Biology* 138:517–525
- Bastidas C, Benzie JAH, Fabricius KE (2002) Genetic differentiation among populations of the brooding soft coral *Clavularia koellikeri* on the Great Barrier Reef. *Coral Reefs* 21:233–241
- Bastidas C, Croquer A, Zubillaga AL, Ramos R, Kortnik V, Weinberger C, Marquez LM (2005) Coral mass- and split-spawning at a coastal and an offshore Venezuelan reefs, southern Caribbean. *Hydrobiologia* 541:101–106
- Beazley L, Kenchington E (2010) Reproductive biology of the cold-water coral *Acanella arbuscula*, Northwest Atlantic. 12th International Deep-Sea Biology Symposium. University of Iceland, Reykjavik, Iceland p 4
- Ben-David-Zaslow R, Benayahu Y (1996) Longevity, competence and energetic content in planulae of the soft coral *Heteroxenia fuscescens*. *J Exp Mar Biol Ecol* 206:55–68
- Ben-David-Zaslow R, Benayahu Y (1998) Competence and longevity in planulae of several species of soft corals. *Mar Ecol Prog Ser* 163:235–243
- Ben-David-Zaslow R, Benayahu Y (1999) Temporal variation in lipid, protein and carbohydrate content in the Red Sea soft coral *Heteroxenia fuscescens*. *J Mar Biol Assoc U K* 79:1001–1006
- Ben-David-Zaslow R, Benayahu Y (2000) Biochemical composition, metabolism, and amino acid transport in planula-larvae of the soft coral *Heteroxenia fuscescens*. *J Exp Zool* 287:401–412
- Ben-David-Zaslow R, Henning G, Hofmann DK, Benayahu Y (1999) Reproduction in the Red Sea soft coral *Heteroxenia fuscescens*: seasonality and long-term record (1991–1997). *Mar Biol* 133:553–559
- Ben-Yosef DZ, Benayahu Y (1999) The gorgonian coral *Acabaria biserialis*: Life history of a successful colonizer of artificial substrata. *Mar Ecol Prog Ser* 163:235–243
- Benayahu Y (1989) Reproductive cycle and developmental processes during embryogenesis of *Clavularia hamra* (Cnidaria, Octocorallia). *Acta Zoologica* 70:29–36
- Benayahu Y (1991) Reproduction and developmental pathways of Red Sea Xenidiidae (Octocorallia, Alcyonacea). *Hydrobiologia* 216-217:125–130
- Benayahu Y (1997) Developmental episodes in reef soft corals: Ecological and cellular determinants. *Proceedings from the 8th International Coral Reef Symposium* 2:1213–1218
- Benayahu Y, Loya Y (1983) Surface brooding in the Red Sea soft coral *Parerythropodium fulvum fulvum* (Forskal, 1775). *Biol Bull* 165:353–369

- Benayahu Y, Loya Y (1984a) Substratum preferences and planulae settling of two Red Sea Alcyonaceans: *Xenia macrospiculata* (Gohar) and *Parerythropodium fulvum fulvum* (Forskal). *J Exp Mar Biol Ecol* 83:249–261
- Benayahu Y, Loya Y (1984b) Life history studies on the Red Sea soft coral *Xenia macrospiculata* Gohar, 1940. II. Planulae shedding and post larval development. *Biol Bull* 166:44–53
- Benayahu Y, Loya Y (1984c) Life history studies on the Red Sea soft coral *Xenia macrospiculata* Gohar, 1940. I. Annual dynamics of gonadal development. *Biol Bull* 166:32–43
- Benayahu Y, Loya Y (1985) Settlement and recruitment of a soft coral: Why is *Xenia macrospiculata* a successful colonizer. *Bull Mar Sci* 36:177–188
- Benayahu Y, Loya Y (1986) Sexual reproduction of a soft coral: Synchronous and brief annual spawning of *Sarcophyton glaucum* (Quoy & Gaimard, 1833). *Biol Bull* 170:32–42
- Benayahu Y, Schleyer MH (1998) Reproduction in *Anthelia glauca* (Octocorallia: Xeniidae). II. Transmission of algal symbionts during planular brooding. *Mar Biol* 131:433–442
- Benayahu Y, Achituv Y, Berner T (1988) Embryogenesis and acquisition of algal symbionts by planulae of *Xenia umbellata* (Octocorallia: Alcyonacea). *Mar Biol* 100:93–101
- Benayahu Y, Berner T, Achituv Y (1989) Development of planulae within a mesogleal coat in the soft coral *Heteroxenia fuscescens*. *Mar Biol* 100:203–210
- Benayahu Y, Weil D, Kleinman M (1990) Radiation of broadcasting and brooding patterns in coral reef alcyonaceans. In: Hoshi M, Yamashita O (eds) *Advances in Invertebrate Reproduction* 5. Elsevier, Amsterdam, p 323–328
- Bermas NA, Alino PM, Atrigenio MP, Uychiaoco A (1992) Observations on the reproduction of scleractinian and soft corals in the Philippines. *Proceedings of the 7th International Coral Reef Symposium* 1:443–447
- Bowden B, Coll J, Tapiola D, Willis R (1985) Some chemical aspects of spawning in alcyonacean corals. *Proceedings of the 5th International Coral Reef Symposium* 4:325–329
- Brazeau D (1989) A male-biased sex ratio in the Caribbean octocoral, *Briareum asbestinum*: sex ratio evolution in clonal organisms. Ph.D. thesis, State University of New York at Buffalo, NY,
- Brazeau DA (1992) Growth rates and growth strategy in a clonal marine invertebrate, the Caribbean octocoral *Briareum abstinum*. *Biol Bull* 183:269–277
- Brazeau DA, Lasker HR (1989) The reproductive cycle and spawning in a Caribbean gorgonian. *Biol Bull* 176:1–7
- Brazeau DA, Lasker HR (1990) Sexual reproduction and external brooding by the Caribbean gorgonian *Briareum asbestinum*. *Mar Biol* 104:465–474
- Brito TAS (1993) Taxonomic and ecological studies on Antarctic octocorals of the genus *Thouarella* (Octocorallia, Primoidae). Ph.D. thesis, University of Southampton, p 272
- Brito T, Tyler P, Clarke A (1997) Reproductive biology of the Antarctic octocoral *Thouarella variabilis* Wright and Studer 1889. *Proc 6 Int Conf on Coelenterate Biology* 1995:63–69
- Chang Tc (2007) Sexual reproduction of four gorgonian corals in southern Taiwan. Masters thesis, National Sun Yet-sen University p 46
- Chia FS, Crawford BJ (1973) Some observations on gametogenesis, larval development and substratum selection of the sea pen *Ptilosarcus guernei*. *Mar Biol* 23:73–82
- Cho IY, Song JI (2008) Reproductive biology, embryogenesis and larval development of the gorgonian *Calicogorgia granulosa* (Gorgonacea: Plexauridae). 11th International Coral Reef Symposium, Fort Lauderdale, FL p 97
- Choi EJ, Song JI (2007) Reproductive biology of the temperate soft coral *Dendronephthya suenonii* (Alcyonacea: Nephtheidae). *Integrative Biosciences* 11:215–225
- Chou YH (2002) Sexual reproduction of three alcyonacean species in southern Taiwan. Masters of Science thesis, National Taiwan University p49 p
- Coma R, Lasker H (1997) Small-scale heterogeneity of fertilization success in a broadcast spawning octocoral. *J Exp Mar Biol Ecol* 214:107–210
- Coma R, Zabala M, Gill JM (1995a) Sexual reproductive effort in the Mediterranean gorgonian *Paramuricea clavata*. *Mar Ecol Prog Ser* 117:185–192

- Coma R, Ribes M, Zabala M, Gili JM (1995b) Reproduction and cycle of gonadal development in the Mediterranean gorgonian *Paramuricea clavata*. Mar Ecol Prog Ser 117:173–183
- Cooper TF, Ulstrup KE, Dandan SS, Heyward AJ and others (2010) Niche specialization of reef-building corals in the mesophotic zone: metabolic trade-offs between divergent Symbiodinium types. Proc Biol Sci. doi:10.1098/rspb.2010.2321
- Cordes EE, Nybakken JW, VanDykhuizen G (2001) Reproduction and growth of *Anthomastus ritteri* (Octocorallia: Alcyonacea) from Monterey Bay, California, USA. Mar Biol 138:491–501
- Dahan M, Benayahu Y (1997a) Reproduction of *Dendronephythya hemprichi* (Cnidaria: Octocorallia): year-round spawning in an azooxanthellate soft coral. Mar Biol 129:573–579
- Dahan M, Benayahu Y (1997b) Clonal propagation by the azooxanthellate octocoral *Dendronephythya hemprichi*. Coral Reefs 16:5–12
- Dahan M, Benayahu Y (1998) Embryogenesis, planulae longevity, and competence in the octocoral *Dendronephythya hemprich*. Invertebr Biol 117:271–280
- Davis SA (1977) Some aspects of the biology of *Anthelia edmondsoni* (Verrill). Master of Science thesis, University of Hawaii, p 75
- Eckelbarger KJ, Tyler PA, Langton RW (1998) Gonadal morphology and gametogenesis in the sea pen *Pennatula aculeata* (Anthozoa: Pennatulacea) from the Gulf of Maine. Mar Biol 132:677–690
- Edwards D, Moore C (2008) Reproduction in the sea pen *Pennatula phosphorea* (Anthozoa: Pennatulacea) from the west coast of Scotland. Mar Biol 155:303–314
- Excoffon AC, Acuna FH, Zamponi MO, Genzano GN (2004) Reproduction of the temperate octocoral *Tripalea clavaria* (Octocorallia: Anthothelidae) from sublittoral outcrops off Mar del Plata, Argentina. J Mar Biol Assoc U K 84:695–699
- Fan TY, Chou YH, Dai CF (2005) Sexual reproduction of the alcyonacean coral *Lobophytum pauciflorum* in southern Taiwan. Bull Mar Sci 76:143–154
- Farrant PA (1985) Reproduction in the temperate Australian soft coral *Capnella gaboensis*. Proceedings of the 5th International Coral Reef Symposium 4:1985
- Farrant PA (1986) Gonad development and the planulae of the temperate Australian soft coral *Capnella gaboensis*. Mar Biol 92:381–392
- Ferreira MCCS (2009) Biologia reprodutiva de *Phyllogorgia dilatata* (Esper 1806) (Cnidaria, Anthozoa, Octocorallia) de recifes de coral de Porto Seguro, Bahai. Museu Nacional/UFRJ, p 82
- Fine M, Aluma Y, Meroz-Fine E, Abelson A, Loya Y (2005) *Acabaria erythraea* (Octocorallia: Gorgonacea) a successful invader to the Mediterranean Sea? Coral Reefs 24:161–164
- Fitzsimmons-Sosa K, Hallock P, Wheaton J, Hackett K, Callahan M (2004) Annual cycles of gonadal development of six common gorgonians from Biscayne National Park, Florida, USA. Caribb J Sci 40:144–150
- Flynn KF (2008) Impact of the fungal disease aspergillosis on populations of the sea fan *Gorgonia ventalina* (Octocorallia, Gorgonacea) in La Parguera, Puerto Rico. Masters of Science thesis, University of Puerto Rico, p87
- Garrabou J (1999) Life-history traits of *Alcyonium acaule* and *Parazoanthus axinellae* (Cnidaria, Anthozoa), with emphasis on growth. Mar Ecol Prog Ser 178:193–204
- Gohar HAF (1940a) Studies on the Xenidiidae of the Red Sea. Publications of the Marine Biological Station Ghardaqa 2:27–118
- Gohar HAF (1940b) The development of some Xenidiidae (Alcyonaria) (with some ecological aspects). Publications of the Marine Biological Station Ghardaqa 3:27–70
- Gohar HAF (1948) A description and some biological studies of a new alcyonarian species *Clavularia hamra* Gohar. Publications of the Marine Biological Station Ghardaqa 6:3–33
- Gohar H, Roushdy H (1961) On the embryology of the Xenidiidae (Alcyonaria)(with notes on the extrusion of the larvae). Publications of the Marine Biological Station Ghardaqa 11:45–70
- Goldberg WM, Hamilton RD (1974) The sexual cycle in *Plexaura homomalla*. In: Bayer FM, Weinheimer AJ (eds) Prostaglandins from *Plexaura homomalla*: Ecology, utilization and

- conservation of a major medical marine resource. University of Florida Press, Coral Gables, p 165
- Gori A, Linares C, Rossi S, Coma R, Gili JM (2007) Spatial variability in reproductive cycle of the gorgonians *Paramuricea clavata* and *Eunicella singularis* (Anthozoa, Octocorallia) in the Western Mediterranean Sea. *Mar Biol* 151:1571–1584
- Gotelli N (1991) Demographic models for *Leptogorgia virgulata*, a shallow-water gorgonian. *Ecology* 72:457–467
- Grigg RW (1970) Ecology and population dynamics of the gorgonians, *Muricea California* and *M. fruticosa*. University of California at San Diego,
- Grigg RW (1976) Fisheries management of precious and stony corals in Hawaii. UNIH-SEAGRANT-TR77-03. University of Hawaii Sea Grant, Honolulu p 48
- Grigg RW (1977) Population Dynamics of Two Gorgonian Corals. *Ecology* 58:278–290
- Grigg RW (1979) Reproductive ecology of two species of gorgonian corals: Relations to vertical and geographical distribution. In: Stanyck SE (ed) Reproductive ecology of marine invertebrates, No 9. University of South Carolina Press, Columbia, p 41–59
- Groot S, Weinberg S (1982) Biogeography, Taxonomical Status and Ecology of *Alcyonium (Parerythropodium) coralloides* (PALLAS, 1766). *Mar Ecol (Berl)* 3:293–312
- Gutierrez-Rodriguez C, Lasker HR (2004) Reproductive biology, development, and planula behavior in the Caribbean gorgonian *Pseudopterogorgia elisabethae*. *Invertebr Biol* 123:54–67
- Harii S, Kayanne H (2002) Larval settlement of corals in flowing water using a racetrack flume. *Mar Technol Soc J* 36:76–79
- Harii S, Kayanne H (2003) Larval dispersal, recruitment, and adult distribution of the brooding stony octocoral *Heliopora coerulea* on Ishigaki Island, southwestern Japan. *Coral Reefs* 22: 188–196
- Harii S, Kayanne H, Takigawa H, Hayashibara T, Yamamoto M (2002) Larval survivorship, competency periods and settlement of two brooding corals, *Heliopora coerulea* and *Pocillopora damicornis*. *Mar Biol* 141:39–46
- Harrison PL (2010) Sexual Reproduction of Scleractinian Corals. In: Dubinsky Z, Stambler N (eds) *Coral Reefs: An Ecosystem in Transition*. Springer, Dordrecht, pp59-85
- Hartnoll RG (1975) The annual cycle of *Alcyonium digitatum*. *Estuar Coast Mar Sci* 3:71–78
- Hartnoll RG (1977) Reproductive strategy in two British species of *Alcyonium*. In: Keegan BF, Ceidigh PO, Boaden PJS (eds) *Biology of benthic organisms 11th European symposium on marine biology Galway, October 1976*. Pergamon Press, Oxford, p 321–328
- Henry L, Kenchington E, Silvaggio A (2003) Effects of mechanical experimental disturbance on aspects of colony responses, reproduction, and regeneration in the cold-water octocoral *Gersemia rubiformis*. *Canadian Journal of Zoology/Revue Canadienne de Zoologie* 81:1691–1701
- Hickson S (1900) The Alcyonaria & Hydrocorallinae of the Cape of Good Hope. *Marine Investigations in South Africa* 1:67–96
- Hickson S (1931) The alcyonarian family Xeniididae, with a revision of the genera and species. *Great Barrier Reef Expedition 1928-29, IV* 5:18–179
- Hwang SJ, Song JI (2007) Reproductive biology and larval development of the temperate soft coral *Dendronephthya gigantea* (Alcyonacea: Nephtheidae). *Mar Biol* 152:273–284
- Hwang SJ, Song JI (2008) Reproductive Biology Of Temperate Soft Corals (Alyonacea: Nephtheidae) in Korean Waters. 11th International Coral Reef Symposium, Fort Lauderdale, FL p 98
- Kahng SE (2006) Ecology and ecological impact of an alien octocoral, *Carijoa riisei*, in Hawaii. Ph.D. thesis, University of Hawaii, p 284
- Kahng SE, Benayahu Y, Wagner D, Rothe N (2008) Sexual reproduction in the invasive octocoral, *Carijoa riisei* (Duchassaing & Michelotti, 1860), in Hawaii. *Bull Mar Sci* 82:1–17
- Kapela W, Lasker HR (1999) Size-dependent reproduction in the Caribbean gorgonian *Pseudoplexaura porosa*. *Mar Biol* 135:107–114

- Kinzie R (1970) The ecology of the gorgonians (Cnidaria, Octocorallia) of Discovery Bay, Jamaica. Ph.D. thesis, Yale University, p 107
- Kinzie R (1974) *Plexaura Homomalla*: The biology and ecology of a harvestable marine resource. In: Bayer F, Weinheimer A (eds) Prostaglandins from *Plexaura homomalla*: Ecology, Utilization and Conservation of a Major Medical Marine Resource A Symposium. University of Miami Press, Coral Gables, Florida, p 22–38
- Kruger A, Schleyer MH, Benayahu Y (1998) Reproduction in *Anthelia glauca* (Octocorallia: Xeniidae). I. Gametogenesis and larval brooding. *Mar Biol* 131:423–432
- Lasker H, Kim K (1996) Larval development and settlement behavior of the gorgonian coral *Plexaura kuna*. *J Exp Mar Biol Ecol* 207:161–175
- Lasker HR, Brazeau DA, Calderon J, Coffroth MA, Coma R, Kim K (1996) *In situ* rates of fertilization among broadcast spawning gorgonian corals. *Biol Bull* 190:45–55
- Lasker H, Kim K, Coffroth M (1998) Production, settlement, and survival of plexaurid gorgonian recruits. *Mar Ecol Prog Ser* 162:111–123
- Linares C, Coma R, Zabala M (2008a) Effects of a mass mortality event on gorgonian reproduction. *Coral Reefs* 27:27–34
- Linares C, Coma R, Mariani S, Diaz D, Hereu B, Zabala M (2008b) Early life history of the Mediterranean gorgonian *Paramuricea clavata*: implications for population dynamics. *Invertebr Biol* 127:1–11
- Mackenzie FT, Lerman A (2006) Carbon in the geobiosphere: Earth's outer shell. Springer Verlag, Dordrecht, The Netherlands
- Matsumoto A (1997) Growth and reproduction of *Melithaea flabellifera*. Masters of Science thesis, Ochanomizu University,
- Matsumoto AK (2004) Heterogenous and compensatory growth in *Melithaea flabellifera* (Octocorallia: Melithaeidae) in Japan. *Hydrobiologia* 530/531:389–397
- McFadden CS (1991) A comparative demographic analysis of clonal reproduction in a temperate soft coral. *Ecology* 72:1849–1866
- McFadden CS (1997) Contributions of sexual and asexual reproduction to population structure in the clonal soft coral, *Alcyonium rudyi*. *Evolution* 51:112–126
- McFadden CS (1999) Genetic and taxonomic relationships among Northeastern Atlantic and Mediterranean populations of the soft coral *Alcyonium coralloides*. *Mar Biol* 133:171–184
- McFadden CS (2001) A molecular phylogenetic analysis of reproductive trait evolution in the soft coral genus *Alcyonium*. *Evolution* 55:54–67
- McFadden CS, Hochberg FG (2003) Biology and taxonomy of encrusting alcyoniid soft corals in the northeastern Pacific Ocean with descriptions of two new genera (Cnidaria, Anthozoa, Octocorallia). *Invertebr Biol* 122:93–113
- McFadden CS, France SC, Sanchez JA, Alderslade P (2006) A molecular phylogenetic analysis of the Octocorallia (Cnidaria: Anthozoa) based on mitochondrial protein-coding sequences. *Mol Phylogenet Evol* 41:513–527
- Mercier A, Hamel JF (2011) Contrasting reproductive strategies in three deep-sea octocorals from eastern Canada: *Primnoa resedaeformis*; *Keratoisis ornata*, and *Anthomastus grandiflorus*. *Coral Reefs* 30:337–350
- Nobchinwong P, Yeemin T (2004) Reproduction of a soft coral, *Cladiella tuberosa* Tixier-Durivault, (Cnidaria: Anthozoa: Alcyonacea) in coral communities of the inner and the eastern gulf of Thailand. 10th International Coral Reef Symposium. Japanese Coral Reef Society, Okinawa, Japan p 369
- Orejas C, Lopez-Gonzales PJ, Gili JM, Teixido N, Gutt J, Arntz W (2002) Distribution and reproductive ecology of the Antarctic octocoral *Ainigmaptilon antarcticum* in the Weddell Sea. *Mar Ecol Prog Ser* 231:101–114
- Orejas C, Gili JM, Lopez-Gonzalez PJ, Hasemann C, Arntz WE (2006) Reproduction patterns of four Antarctic octocorals in the Weddell Sea: an interspecific, shape, and latitude comparison. *Mar Biol* 150:551–563

- Pakes M, Woollacott R (2008) Reproduction of the gorgonian *Plexaura flexuosa* in Bermuda. *J Exp Mar Biol Ecol* 357:121–127
- Pires DO, Castro CB, Silva JC (2009) Reproductive biology of the deep-sea pennatulacean *Anthoptilum murrayi* (Cnidaria, Octocorallia). *Mar Ecol Prog Ser* 397:103–112
- Ribes M, Coma R, Rossi S, Micheli M (2007) Cycle of gonadal development in *Eunicella singularis* (Cnidaria: Octocorallia): trends in sexual reproduction in gorgonians. *Invertebr Biol* 126:307–317
- Rice AL, Tyler PA, Patterson GJL (1992) The pennatulid *Kophobelemnon stelliferum* (Cnidaria: Octocorallia) in the Porcupine Seabight (North-East Atlantic Ocean). *J Mar Biol Assoc U K* 72:417–434
- Santangelo G, Carletti E, Maggi E, Bramanti L (2003) Reproduction and population sexual structure of the overexploited Mediterranean red coral *Corallium rubrum*. *Mar Ecol Prog Ser* 248:99–108
- Santangelo G, Maggi E, Bramanti L, Bongiorno L (2004) Demography of the over-exploited Mediterranean red coral (*Corallium rubrum* L. 1758). *Sci Mar* 68:199–204
- Santangelo G, Bramanti L, Iannelli M (2007) Population dynamics and conservation biology of the over-exploited Mediterranean red coral. *J Theor Biol* 244:416–423
- Satterlie R, Case J (1979) Development of Bioluminescence and Other Effector Responses in the Pennatulid Coelenterate *Renilla koellikeri*. *Biol Bull* 157:506–523
- Schleyer MH, Kruger A, Benayahu Y (2004) Reproduction and the unusual condition of hermaphroditism in *Sarcophyton glaucum* (Octocorallia, Alyoniidae) in KwaZulu-Natal, South Africa. *Hydrobiologia* 530/531:399–409
- Sebens KP (1983a) The larval and juvenile ecology of the temperate octocoral *Alcyonium siderium* Verrill. II. Fecundity, survival, and juvenile growth. *J Exp Mar Biol Ecol* 72:263–285
- Sebens KP (1983b) The larval and juvenile ecology of the temperate octocoral *Alcyonium siderium* Verrill. I. Substratum selection by benthic larvae. *J Exp Mar Biol Ecol* 71:73–89
- Sebens KP (1983c) Settlement and metamorphosis of a temperate soft-coral larva *Alcyonium siderium* Verrill. II. Induction by crustose algae. *Biol Bull* 165:286–304
- Seo S, Hwang S, Im Song J (2008) Sexual Reproduction of *Anthoplexaura dimorpha* (Gorgonacea: Octocorallia) from Munseom, Jeju Islands, Korea. *Animal Cells and Systems* 12:231–240
- Simpson A (2005) Reproductive morphology of two deep-water octocorals, *Paramuricea placomus* (Plexauridae) and *Metallogorgia melanotrichos* (Chrysogorgiidae). 3rd International Symposium on Deep-Sea Corals. Rosenstiel School of Marine and Atmospheric Sciences, University of Miami, Miami, FL p 203
- Slattery M, Hines GA, Starmer J, Paul VJ (1999) Chemical signals in gametogenesis, spawning, and larval settlement and chemical defense of the soft coral *Sinularia polydactyla*. *Coral Reefs* 18:75–84
- Soong K (2005) Reproduction and colony integration of the sea pen *Virgularia juncea*. *Mar Biol* 146:1103–1109
- Sun Z, Hamel JF, Mercier A (2009) Planulation of deep-sea octocorals in the NW Atlantic. *Coral Reefs* 28:781
- Sun Z, Hamel JF, Mercier A (2010) Planulation periodicity, settlement preferences and growth of two deep-sea octocorals from the northwest Atlantic. *Mar Ecol Prog Ser* 410:71–87
- Suzuki H (1971) Notes on *Cornularia* (Stolonifera, Alcyonaria) Found in the Vicinity of the Manazuru Marine Biological Laboratory. Science reports of the Yokohama National University Section II, Biological and geological sciences 18:1–6d
- Torrents O, Garrabou J, Marschal C, Harmelin JG (2005) Age and size at first reproduction in the commercially exploited red coral *Corallium rubrum* (L.) in the Marseilles area (France, NW Mediterranean). *Biol Conserv* 121:391–397
- Tremblay M, Henry J, Anctil M (2004) Spawning and gamete follicle rupture in the cnidarian *Renilla koellikeri*: effects of putative neurohormones. *Gen Comp Endocrinol* 137:9–18

- Tsounis G, Rossi S, Aranguren M, Gili JM, Arntz W (2006) Effects of spatial variability and colony size on the reproductive output and gonadal development cycle of the Mediterranean red coral (*Corallium rubrum* L.). *Mar Biol* 148:513–527
- Tyler P, Bronsdon S, Young C, Rice A (1995) Ecology and gametogenic biology of the genus *Umbellula* (Pennatulacea) in the North Atlantic Ocean. *Int Rev Gesamten Hydrobiol Hydrograph* 80:187–199
- Vermeire MJ (1994) Reproduction and growth of a gorgonian sea whip, *Junceella fragilis*, in southern Taiwan Master of Science thesis, National Taiwan University
- Waller RG, Baco AR (2007) Reproductive morphology of three species of deep-water precious corals from the Hawaiian Archipelago: *Gerardia* sp., *Corallium secundum*, and *Corallium lauuense*. *Bull Mar Sci* 81:533–542
- Wilson EB (1883) The development of *Renilla*. *Philos Trans R Soc Lond B Biol Sci* 174:723–815
- Wu CS (1994) Sexual reproduction and population structure of three *Sinularia* species in Nanwan Bay. Masters of Science thesis, National Taiwan University p 44
- Yamazato K, Sato M, Tamashiro H (1981) Reproductive biology of an alcyonacean coral, *Lobophytum crassum* Marenzeller. *Proceedings of the 4th International Coral Reef Symposium* 2:671–678
- Yeung CW, Ang P (2008) Sexual Reproduction in the Soft Coral *Lobophytum* sp. in Tung Ping Chau Marine Park, Hong Kong SAR, China. *Proceedings of the 11th International Coral Reef Symposium* 1:378–381
- Yoshioka BB (1979) Aspects of the ecology of *Pseudopterogorgia americana* and *Pseudopterogorgia acerosa*. M.S. thesis, University of Puerto Rico, Mayaguez, p 105n