

Systematic Relationship of the Anthozoan Orders Based on the Partial Nuclear 18S rDNA Sequences

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Key Words:

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Systematic relationship of 13 species representing seven orders of anthozoans, and one hydrozoan as an outgroup, were investigated. Distance and parsimony methods were used to analyze nucleotide sequence data obtained from the 18S rDNA. The inferred phylogeny indicates that two orders, Ceriantharia and Antipatharia within subclass Ceriantipatharia, are not closely related to each other. Instead, the former appears to be the most ancestral group among anthozoans but the latter is more closely related to order Actiniaria within subclass Zoantharia. The result also indicates that the actiniarian may not be a monophyletic group, because *Epiactis japonica* is related more to order Scleractinia. Subclass Octocorallia appears to be a monophyletic group, within which order Pennatulacea diversified at first, and then orders Alcyonacea and Gorgonacea diversified later.

Class Anthozoa comprises about two thirds of known species in the phylum Cnidaria, which has been regarded as the most primitive taxon among all eumetazoans (Hyman, 1940; Dodson, 1960; Barnes, 1987), and ecologically lie in a very important position of marine biodiversity. Anthozoans distinguished from the other cnidarians, have only the polypoid stage and biradial symmetric mesenteries, so that previous classifications were mainly based on the number and features of its mesenteries.

There are two conflicting views whether to group two or three subclasses within Anthozoa. Two subclass scheme includes Octocorallia, with eight mesenteries and pinnate tentacles, and Zoantharia, with the coupled and paired mesenteries usually in multiples of six, (Hyman, 1940; Barnes, 1987; Manuel, 1988). In the three subclass scheme, two orders, Ceriantharia and Antipatharia, separated from the Zoantharia, constitute the third subclass Ceriantipatharia due to the mesenteries with feeble musculature (Wells and Hill, 1956; Dunn, 1982; Brusca and Brusca, 1990). Therefore, the systematic relationships of subclasses and orders within the class Anthozoa have remained unresolved.

Recently, molecular techniques have been used to the systematics for more objective phylogenetic analysis. In particular, DNA sequence data provide powerful tools to deduce the phylogenetic relationships among various organisms (Field et al., 1986, 1988; Turbeville et al., 1994; Wada and Satoh, 1994; Berbee, 1996).

In the present study, we used the nucleotide sequences of 18S rRNA gene to test some hypotheses about the phylogenetic relationships among groups of anthozoans.

Materials and Methods

Specimens were selectively collected from the southern part of Korea, to provide a wide sampling of orders within Anthozoa, between 1993 and 1994. Nine representative anthozoans belonging to three subclasses and one hydrozoan as an outgroup were collected and sequenced. Nuclear 18S rDNA sequence data for 14 species including four anthozoan species with previously published sequences were analysed together to clarify the relationships of them. Table 1 lists the anthozoans used in this study and gives the sources for the sequences. The ten new sequences (one hydrozoan, four octocorals, four zoantharians and one ceriantipatharian) are marked with asterisks.

DNA was extracted from polyps in octocorals, scleractinians, and antipatharians and from mesenteric filaments in actiniarians as described by Sambrook et al. (1989). Anthozoans with skeleton had been submerged for two or three days in 0.5 M EDTA before the extraction.

A pair of primers were selected to permit amplification of 18S rRNA gene (5'-CCTGGTTGATCCT GCCAG-3', 5'-TAATGATCCTCCGCAGGTT-3'). A PCR-reaction was carried out using the following protocol: 1 cycle at 95°C (5 min), 52°C (2 min), and 72°C (10 min); 35 cycles at 94°C (1 min), 52°C (2 min), 72°C (3 min); and 1 cycle at 94°C (1 min), 52°C (2 min), 72°C (10 min). PCR products were purified by

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Table 1. Summary of taxonomic information for the species used in this study

Classification	Accession number	DNA source
Phylum Cnidaria		
Class Hydrozoa		
Order Hydroida		
Suborder Thecata		
Family Sertulariidae		
* <i>Selaginopsis cornigera</i>	EMBL Z292899	polyps
Class Anthozoa		
Subclass Octocorallia		
Order Gorgonacea		
Family Paramuriceidae		
* <i>Calicogorgia granulosa</i>	EMBL Z292900	polyps
Family Plexauridae		
* <i>Euplexaura crassa</i>	EMBL Z292901	polyps
Order Alcyonacea		
Family Alcyoniidae		
* <i>Alcyonium gracillimum</i>	EMBL Z292902	polyps
<i>Bellonella rigida</i>	EMBL Z49195	
Order Pennatulacea		
Family Pennatulidae		
* <i>Leiopathes fimbriatus</i>	EMBL Z292903	polyps
Subclass Zoantharia		
Order Actiniaria		
Family Actiniidae		
<i>Anemonia sulcata</i>	EMBL X53498	
<i>Anthopleura kurogane</i>	EMBL Z21671	
* <i>Epiactis japonica</i>	EMBL Z292904	mesenteric filaments
Family Isophelliidae		
* <i>Flosmaris mutsuensis</i>	EMBL Z292905	mesenteric filaments
Order Scleractinia		
Family Dendrophylliina		
* <i>Tubastraea aurea</i>	EMBL Z292906	polyps
* <i>Rhizopsammia minuta mutsuensis</i>	EMBL Z292907	polyps
Subclass Ceriantipatharia		
Order Antipatharia		
Family Antipathidae		
* <i>Antipathes lata</i>	EMBL Z292908	polyps
Order Ceriantharia		
Family Cerianthidae		
** <i>Cerianthus filiformis</i>		polyps

* 18S rDNAs of the species were sequenced.

** Cited from Song et al., 1994

quick-spin PCR purification kit (QIAGEN), and cloned into pT7 Blue T-vector (QIAGEN). Sequencing was

conducted using thirteen primers (Table 2) and Taqtrack kit (Promega).

Sequencing data were aligned using CLUSTAL V program (Higgins et al., 1992), and then highly divergent regions that could not be reliably aligned were excluded from the analyses. Phylogenetic analyses were performed using both parsimony and distance methods. In parsimony method, the branch-and-bound search option in PAUP 3.1.1 (Swofford, 1991) with 100 bootstraps was used. Distance analyses were carried out using the NEIGHBOR program in PHYLIP 3.5c (Felsenstein, 1993) in conjunction with SEQBOOT, after initially calculating the distance matrices using the DNADIST with Kimura's model.

Results

The alignment of the 18S rDNA sequences of each species is shown in Appendix 1. The total number of nucleotides included in the analyses was from 807

Fig. 1. Phylogenetic relationships within the Anthozoa inferred from distance matrix methods using the hydrozoan *S. cornigera* as an outgroup. Neighbor-joining analysis by Kimura's 2-parameter distance was used. Numbers on branches indicate the percentage of 100 bootstraps supporting the branching pattern shown.

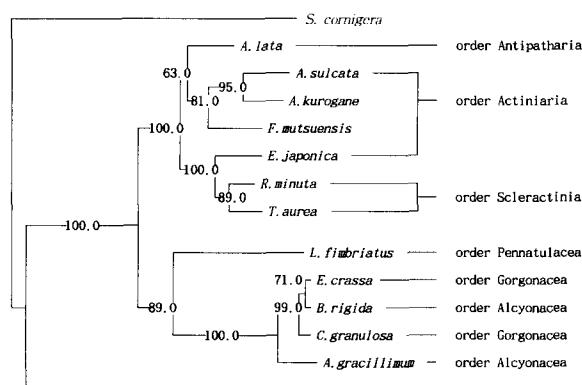


Table 2. A list of primers used to sequence 18S rDNA in this study

Position ^a and vector primer	Primer sequence
32	5' ACCTTGTACGACTTTA 3'
162	5' ACGGGCCTGTGTAC 3'
362	5' TCTAAGGGCATCACA 3'
477	5' TCTCGTTCGTATCG 3'
530	5' CCATGCACCAACCC 3'
657	5' CGCTCAATTCTTAAGTT 3'
873	5' CCAAGAAATTCAACC 3'
1028	5' TAATTTTTCAAAGT 3'
1207	5' GAATTACCGCGGCTG 3'
1423	5' ATTCCCCGTCACCG 3'
1631	5' ACCTCTAGAATTACC 3'
T7 promoter primer	5' TAATACGACTCACYATAGGG 3'
U-19mer primer (reverse)	5' GTTTCCCAGTCACGACGT 3'

^aIndicates the position of each primer's 5' base on the *Placoplecten magellanicus* 18S ribosomal gene (Rice, 1990).

to 816. The alignment has 223 variable sites, of which 97 sites are informative for parsimony analysis.

Pairwise estimates of sequence divergence across all taxa ranged from 0.2% (between two octocorals, *Euplexaura crassa* and *Bellonella rigida*) to 13% (between *Selaginopsis cornigera* and one of the octocorals *Alcyonium gracillimum*) (Table 3). The average percent divergence between the outgroup, *S. cornigera* and the other taxa was 12.6% (SE=0.53). *Cerianthus filiformis* was also considerably divergent from the other anthozoans (average=10.9, SE=0.63). *Antipathes lata* was related more to the zoantharians (average=3.2%) rather than *C. filiformis* (9.8%), which was classified in subclass Ceriantipatharia with *A. lata*. Five species of octocorals were much similar to each other and *Leiopathes fimbriatus* was more divergent than the other octocorals.

Fig. 1 shows the neighbor-joining tree based on Kimura's distance (Table 3) with bootstrap values. The first branch in the tree led to *C. filiformis* and the others formed two large clades, the octocorallian and the zoantharian clade. In the octocorallian clade, a pennatulacean, *L. fimbriatus* came off at first, followed by two branches leading to an alcyonacean, *A. gracillimum*, and a gorgonacean, *C. granulosa*. The others formed a node joining a gorgonacean, *E. crassa*, and an alcyonacean, *B. rigida*.

Table 3. Pairwise comparison of the taxa used in this study. Lower left triangle is the estimates of sequence divergence computed by DNADIST(PHYLIP 3.5c) with Kimura's correction, and upper right triangle shows percent divergences calculated by PAUP 3.1.1

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. <i>S. cornigera</i>	-	11.3	11.8	12.2	12.1	12.3	11.8	11.6	12.5	12.5	13.0	12.9	12.7	11.4
2. <i>A. lata</i>	0.1233	-	3.1	3.5	3.0	3.2	3.2	3.4	6.3	6.6	6.6	6.4	6.2	9.8
3. <i>A. sulcata</i>	0.1304	0.0318	-	4.7	4.6	4.8	3.3	2.0	7.7	7.2	7.5	7.3	7.1	10.9
4. <i>E. japonica</i>	0.1340	0.0355	0.0490	-	2.1	2.5	3.7	4.5	6.9	7.1	7.1	6.9	7.1	10.4
5. <i>R. minuta</i>	0.3333	0.0302	0.0475	0.0213	-	1.4	3.7	4.3	6.8	7.0	7.1	6.9	7.1	10.3
6. <i>T. aurea</i>	0.1347	0.0328	0.0502	0.0252	0.0137	-	3.9	4.6	6.2	6.9	6.9	6.8	7.0	10.3
7. <i>F. mutsuensis</i>	0.1293	0.0328	0.0344	0.0381	0.0379	0.0405	-	2.9	6.7	6.7	7.1	6.9	6.7	10.3
8. <i>A. kurogane</i>	0.1272	0.0344	0.0202	0.0464	0.0449	0.0475	0.0292	-	7.7	7.1	7.1	7.2	7.0	10.9
9. <i>L. fimbriatus</i>	0.1390	0.0663	0.0824	0.0734	0.0717	0.0648	0.0704	0.0823	-	6.1	6.6	6.4	6.2	10.8
10. <i>E. crassa</i>	0.1388	0.0693	0.0769	0.0751	0.0747	0.0734	0.0708	0.0755	0.0639	-	1.6	0.5	0.2	11.4
11. <i>A. gracillimum</i>	0.1450	0.0693	0.0796	0.0751	0.0747	0.0733	0.0749	0.0754	0.0693	0.0162	-	1.8	1.5	11.9
12. <i>C. granulosa</i>	0.1436	0.0681	0.0784	0.0739	0.0735	0.0722	0.0737	0.0770	0.0681	0.0049	0.0187	-	0.5	11.6
13. <i>B. rigida</i>	0.1412	0.0656	0.0758	0.0756	0.0752	0.0739	0.0713	0.0744	0.0657	0.0025	0.0150	0.0050	-	11.7
14. <i>C. filiformis</i>	0.1252	0.1060	0.1185	0.1121	0.1117	0.1117	0.1119	0.1187	0.1187	0.1263	0.1322	0.1280	0.1300	-

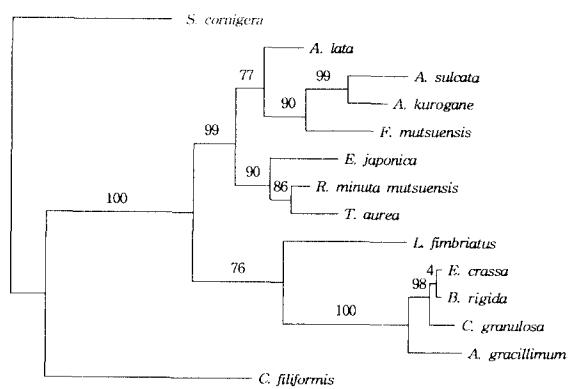


Fig. 2. Relationships within the anthozoans inferred by the most parsimonious tree found using the branch-and-bound search option with 100 bootstrap in PAUP. *S. cornigera* (class Hydrozoa) served as an outgroup. Percentages of bootstrap replicates supporting a branching pattern are given above and below the corresponding branches. The tree length for the parsimony analysis was 300 (consistency index=0.827; retention index=0.805).

Zoantharians were arranged in two clades. In one clade, an actiniarian, *E. japonica*, was clustered with a node of scleractinians that was strongly supported by high bootstrap value (100%). The other actiniarians clustered together but an antipatharian, *A. lata*, also clustered with them, even though actiniarians and antipatharians fall under different subclasses.

The parsimony method generated an exactly same topology (Fig. 2). Bootstrap analysis showed strong support for four clades in both distance and parsimonious trees: a clade grouping all anthozoans except *C. filiformis* (100%), a clade grouping all octocorallians except *L. fimbriatus* (100%), a *A. sulcata/A. kurogane* clade (99%), and a hexacorallian clade with an antipatharian, *A. lata* (99%).

Discussion

Our results strongly suggest that two orders previously placed within subclass Ceriantipatharia (Wells and Hill, 1956) may not be closely related at all. Instead, order Ceriantharia (represented by *C. filiformis*) appears the most primitive within Anthozoa, and

order Antipatharia (represented by *A. lata*) shows closer relationships to Actiniaria within subclass Zoantharia (Figs. 1 and 2).

Although the two orders in Ceriantipatharia are similar in some respects, they also have many differences in external and internal feature. The nematocyst and histology of antipatharians resemble those of sea anemones but their mesogloea and musculatures are greatly reduced (Schmidt, 1974). Wells and Hill (1956) united the two orders under a new subclass Ceriantipatharia because the cerianular larvae of the Ceriantharia closely resemble the antipatharian polyps and both of them have six protocnemes. So, the Antipatharia, formerly considered as degenerated anthozoans, are now regarded as the most primitive living anthozoan with Ceriantharia.

Our molecular analyses shows that the above similarities are superficial, and subclass Ceriantipatharia should include a single order, Ceriantharia only. In addition, order Antipatharia should be considered as one of the most differentiated group of anthozoans. These conclusions are strongly supported by high bootstrap values for both distance and parsimony analyses. However, since we used a single species for each order, more samples are needed to infer clearer relationships between them.

As to relationships within Octocorallia, there have been no detailed molecular approach till now. Octocorallians containing eight orders have been easily classified by their unique morphological characters. The present results are consistent with the monophyly of Octocorallia, and Pennatulacea, among three orders used, came off first and followed Alcyonacea and Gorgonacea. The ancestral octocorallia is then supposed to have no skeleton. However in previous morphological classification on them, Pennatulacea was regarded as the most advanced group in octocorallia (Hyman, 1940; Bayer, 1956; Barnes, 1986). Thus additional approaches on many species representing each orders of octocorals are necessary to determine their relationships in greater detail.

For the evolution of Zoantharia, Hand (1966) and Fautin and Lowenstein (1992) suggested the scleractinian origin of actinarians. However, the results of these analyses are different from their hypothesis based on the morphological data. Two species of scleractinian are clustered together and have a common ancestor with an actinarian, *E. japonica*, though the rest of the four actinarians are clustered to form a different clade. Chen et al. (1995) presented a result similar to our analysis, the late skeletonization in Zoantharia.

There remains a number of unresolved parts. However, the ancestral anthozoan was likely to have the solitary habit and no skeleton such as ceriantharians, and later, divided into two large groups, octocorallians and zoantharians, according to the differentiation of the mesenteries. Then, the skele-

tonization and colonization may have appeared in the two groups independently.

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Appendix 1. Alignment of 18S rDNA sequence data for taxa used (written from 5' to 3' end). Positions included in analysis are marked with arrows(↓). SC=*Selaginopsis cornigera*; AL=*Antipathes lata*; AS=*Anemonia sulcata*; EJ=*Epiactis japonica*; RM=*Rhizopsammia minuta mutsuensis*; TA=*Tubastraea aurea*; FM=*Flosmaris mutsuensis*; AK=*Anthopleura kurogane*; LF=*Leiopathilus fimbriatus*; EC=*Euplexaura crassa*; AG=*Alcyonium gracillimum*; CG=*Calicogorgia granulosa*; BR=*Bellonella rigida*; CF=*Cerianthus filiformis*.

SC	T-CCTGGTTG	ATCCTGOCAG	TAGTCATATG	CITGTCTCAA	AGATTAAGCC	ATGCATGTCT	AAGTATAAGC	ACTTGTACTG
AL	T-CCTGGTTG	ATCCTGOCAG	TAGTCATATG	CITGTCTCAA	AGATTAAGCC	ATGCATGTCT	AAGTATAAGC	ACTTGTACTG
AS	TATCTGGTTG	ATCCTGCCAG	TAGTCATATG	CITGTCTCAA	AGATTAAGCC	ATGCATGTCT	AAGTATAAGC	ACTTGTACTG
EJ	T-CCTGGTTG	ATCCTGOCAG	TAGTCATATG	CITGTCTCAA	AGATTAAGCC	ATGCATGTCT	AAGTATAAGC	ACTTGTACTG
RM	T-CGGGGTTG	ATCCTGCCAG	TAGTCATATG	CITGTCTCAA	AGATTAAGCC	ATGCATGTCT	AAGTATAAGC	ACTTGTACTG
TA	T-CCTGGTTG	ATCCTGCCAG	TAGTCATATG	CITGTCTCAA	AGATTAAGCC	ATGCATGTCT	AAGTATGAGC	ACTTGTACTG
FM	T-CCTGGTTG	ATCCTGCCAG	TAGTCATATG	CITGTCTCAA	AGATTAAGCC	ATGCATGTCT	AAGTATAAGC	ACTTGTACTG
AK	TACCTGGTTG	ATCCTGCCAG	TAGTCATATG	CITGTCTCAA	AGATTAAGCC	ATGCATGTCT	AAGTATAAGC	ACTTGTACTG
LF	T-CCTGGTTG	ATCCTACAG	TAA-CATATG	CITGTCTCAA	AGATTAAGCC	ATGCATGTCT	AAGTATAAGC	ACTTGTACTG
EC	T-CCTGGTTG	ATCCTGCCAG	TA-TCATATG	CITGTCTCAA	AGATTAAGCC	ATGCATGTCT	AAGTATAAGC	ACTTGTACTG
AG	T-CCTGGTTG	ATCCTGCCAG	TA-TCATATG	CITGTCTCAA	AGATTAAGCC	ATGCATGTCT	AAGTATAAGC	ACTTGTACTG
CG	T-CCTGGTTG	ATCCTGCCAG	TA-TCATATG	CITGTCTCAA	AGATTAAGCC	ATGCATGTCT	AAGTATAAGC	ACTTGTACTG
BR	TACCTGGTTG	ATCCTGCCAG	TAGTCATATG	CITGTCTCAA	AGATTAAGCC	ATGCATGTCT	AAGTATAAGC	ACTTGTACTG
CF	TCCCTGGTTG	ATCCTGCCAG	TAGTCATATG	CITGTCTCAA	AGATTAAGCC	ATGCATGTCT	AAGTATAAGC	ACTTGTACTG
SC	TGAAAC-TGC	GAATGGCTCA	TTAACATCAGT	TATTGTTTAC	TTGATTGTCAC	ACTTCT--TA	CATGGATATC	TGTGGT-AAT
AL	TGAA-C-TGC	GAATGGCTCA	TTAACATCAGT	TATCGTTTAT	TTGATTGTCAC	-C-ATTACTA	CITGGATAAC	CGTAGTTAAT
AS	TGAAAC-TGC	GAATGGCTCA	TTAACATCAGT	TATCGTTTAT	TTGATTGTCAC	--GTTTACTA	CITGGATAAC	CGTAGGT-AAT
EJ	TGAA-C-TGC	GAATGGCTCA	TTAACATCAGT	TATCGTTTAT	TTGATTGTCAC	-G-CTTACTA	CITGGATAAC	CGTAGGT-AAT
RM	TGAA-C-TGC	GAATGGCTCA	TTAACATCAGT	TATCGTTTAT	TTGATTGTCAC	-C-TTTACTA	CITGGATAAC	CGTAGT-AAT
TA	TGAA-C-TGC	GAATGGCTCA	TTAACATCAGT	TATCGTTTAT	TTGATTGTCAC	-C-ATTACTA	CITGGATAAC	CGTAGTTAAT
FM	TGAAAC-TGC	GAATGGCTCA	TTAACATCAGT	TATCGTTTAT	TTGATTGTCAC	-CAATTACTA	CITGGATAAC	CGTAGGT-AAT
AK	TGAAAC-TGC	GAATGGCTCA	TTAACATCAGT	TATCGTTTAT	TTGATTGTCAC	--GTTTACTA	CITGGATAAC	CGTAGGT-AAT
LF	TGAA-C-TGC	GAATGGCTCA	TTAACATCAGT	TATCGTTTAT	TTGATTGTCAC	-CTCTTACTA	CITGGATAAC	CGTAGT-AAT
EC	TGAAAC-TGC	GAATGGCTCA	TTAACATCAGT	TATCGTTTAT	TTGATTGTCAC	TCTTTTACTA	CITGGATAAC	CGTAGT-AAT
AG	TGAA-C-TGC	GAATGGCTCA	TTAACATCAGT	TATCGTTTAT	TTGATTGTCAC	CCTCTTACTA	CITGGATAAC	CGTAGT-AAT
CG	TGAAAC-TGC	GAATGGCTCA	TTAACATCAGT	TATCGTTTAT	TTGATTGTCAC	TCTCTTACTA	CITGGATAAC	CGTAGT-AAT
BR	TGAAAC-TGC	GAATGGCTCA	TTAACATCAGT	TATCGTTTAT	TTGATTGTCAC	TCTCATACTA	CITGGATAAC	CGTAGT-AAT
CF	TGAAACCTCC	GAATGGCTCA	TTAACATCAGT	TATCGTTTAT	TTGATTGTCAC	-----	-----	-----
SC	TCTAGAGCTA	ATACATGCCA	AATCTCCCAA	CTT-TACAGG	AAGGGATGTA	TTTATTAGAG	AAAAAACAA	TG-GAGCTT
AL	TCTAGAGCTA	ATACATGCCA	AAAGTCCCGA	CTTCT--GG	AAGGGATGTA	TTTATTAGAT	AAAAAACAA	TGCCGGTT--
AS	TCTAGAGCTA	ATACATGCCA	AGAGTCCCGA	CTTCT--GG	AAGGGATGTA	TTTATTAGAT	TCAAAACAA	TGCCGGTT--
EJ	TCTAGAGCTA	ATACATGCCA	AAAGTCCCGA	CTTCT--GG	AAGGGATGTA	TTTATTAGAT	TCAAAACAA	TGCCGGTT--
RM	TCTAGAGCTA	ATACATGCCA	AAAGTCCCGA	CTTCT--GG	AAGGGATGTA	TTTATTAGAT	AAAAAACAA	TGCCGGTT--
TA	TCTAGAGCTA	ATACATGCCA	AAAGTCCCGA	CTTCT--GG	AAGGGATGTA	TTTACTAGAT	AAAAAACAA	TGCCGGTT--
FM	TCTAGAGCTA	ATACATGCCA	AAAGTCCCGA	CTTTTATCCG	AAGGGATGTA	TTTATTACTA	TCAAAACAA	TGCCGGTT--
AK	TCTAGAGCTA	ATACATGCCA	AAAGTCCCGA	CTTCT--GG	AAGGGATGTA	TTTATTAGAT	TCAAAACAA	TGCCGGTT--
LF	TCTAGAGCTA	ATACATGCCA	AAAGTCCCGA	CTTCT--GG	AAGGGATGTA	TTTATTAGAT	AAATAACAA	TGCCGCAA--
EC	TCTAGAGCTA	ATACATGCCA	AAAGTCCCGA	CTCTCGT-GG	AAGGGATGTA	TTTATTAGAT	AAAAAACAA	TGCCGCTTAA
AG	TCTAGAGCTA	ATACATGCCA	AAAGTCCCGA	CTCTCGT-GG	AAGGGATGTA	TTTATTAGAT	AAAAAACAA	TGCC-CTTCG
CG	TCTAGAGCTA	ATACATGCCA	AAAGTCCCGA	CTCTCGT-GG	AAGGGATGTA	TTTATTAGAT	AAAAAACAA	TGCCGGTTAA
BR	TCTAGAGCTA	ATACATGCCA	AAAGTCCCGA	CTCTCGT-GG	AAGGGATGTA	TTTATTAGAT	AAAAAACAA	TGCCGGTTAA
CF	-----	-----	A CTTTT-----	-----	-----	-----	ACTAA	TG-----
SC	CGG-GGCTCG	CATTAAGAT	GACTCATGAT	AACTTTTCGA	ATCGTAOGGC	CTC-----	-GTGCCGACG	ATATTCTT
AL	---CTGCCCC	GTGCTTTGGT	GATCCATAAT	AACTGATCGA	ATCGCATGCG	CTCG--AGCT	GGCG-----	ATGTTTCATT
AS	---CTGCCCC	GTGCTTTGGT	GATTCATAGT	AACTGATCGA	ATCGCATGCG	CTTG--CGCT	GGCG-----	ATGTTTCATT
EJ	---CTGCCCC	GTGCTTTGGT	GATTCATAGT	AACTGATCGA	ATCGCATGCG	CTTG--CGCT	GGCG-----	ATGTTTCATT
RM	---CTGCCCC	GTGCTTTGGT	GATTCATAGT	AACTGATCGA	ATCGCAOGGC	CTTG--CGCT	GGCG-----	ATGTTTCATT
TA	---CTGCCCC	GTGCTTTGGT	GATTCATAGT	AACTGATCGA	ATCGCAOGGC	CTTG--CGCT	GGCG-----	ATGTTTCATT
FM	---CTGCCCC	GTGCTTTGGT	GATTCATAGT	AACTGATCGA	ATCGCAOGGC	CTCG-A-GCT	GGCG-----	ATGTTTCATT
AK	---CCGCCCC	GTGCTTTGGT	GATTCATAGT	AACTGATCGA	ATCGCAGGGC	CTTG-GGCGT	GGCG-----	G ATGTTTCATT
LF	---TAGCCCC	GTCTTTGGT	GATTCATAAT	AACTTTTCGA	ATCGCATGGC	CTTTCGCGCC	GGCG-----	ATGTTTCATT
EC	CGGCCGCTTA	CCCACCTGGT	GATTCATAGT	AACTGTTGCA	ATCGCATGGC	CTTCTCTGTT	CCTGCCGGCG	ATGTTTCATT
AG	CGGCCGCTTA	CCCACCTGGT	GATTCATAGT	AACTGTTGCA	ATCGCATGGC	CTTCTCTGTT	CCTGCCGGCG	ATGTTTCATT
CG	CGGCCGCTTA	CCCACCTGGT	GATTCATAGT	AACTGTTGCA	ATCGCATGGC	CTTCTCTGTT	CCTGCCGGCG	ATGTTTCATT
BR	CGGCCGCTTA	ACCACCTGGT	GATTCATAGT	AACTGTTGCA	ATCGCATGGC	CTTCTCTGTT	CCTGCCGGCG	ATGTTTCATT
CF	--GTTGTC-	-----TGTT	GATTCATGAT	AACTTTTCGA	ATCGCATGGC	CTT---GCC	GGCG----G	ATGTTTCATT
SC	CAAATTTCTG	CCCTATCAAC	TGTCGATGTT	ACCGTAGTGG	OCTACCATGG	TTTTTAACGG	TGACGGAGAA	TCAGGGTTCG
AL	CAAATTTCTG	CCCTATCAAC	TGTCGATGTT	ACCGTAGTGG	CTTACCATGG	TTACAAACGGG	TGACGGAGAA	TTAGGGTTCG
AS	CAAATTTCTG	CCCTATCAAC	TGTCGATGTT	ACCGTAGTGG	CTTACCATGG	TTACAAACGGG	TGACGGAGAA	TTAGGGTTCG
EJ	CAAATTTCTG	CCCTATCAAC	TGTCGATGTT	ACCGTAGTGG	CTTACCATGG	TTGCAACGGG	TGACGGAGAA	TTAGGGTTCG
RM	CAAATTTCTG	CCCTATCAAC	TGTCGATGTT	ACCGTAGTGG	CTTACCATGG	TTGCAACGGG	TGACGGAGAA	TTAGGGTTCG
TA	CAAATTTCTG	CCCTATCAAC	TGTCGATGTT	ACCGTAGTGG	CTTACCATGG	TTGCAACGGG	TGACGGAGAA	TTAGGGTTCG
FM	CAAATTTCTG	CCCTATCAAC	TGTCGATGTT	ACCGTAGTGG	CTTACCATGG	TTGCAACGGG	TGACGGAGAA	TTAGGGTTCG

(continued)

AK	CAAATTTCTG	CCCTATCAAC	TGTCGATGGT	AAGGTATTGG	CTTACCATGG	TTACAACCGG	TGACGGAGAA	TTAGGGTTCG
LF	CAAATTTCTG	CCCTATCAAT	TGTCGATGGT	AAGGTAGTGG	CTTACCATGG	TTACAACCGG	TGACGGAGAA	TTAGGGTTCG
EC	CAAATTTCTG	CCCTATCAAC	TGTCGATGGT	AAGGTAGTGG	CTTACCATGG	TTACAACCGG	TGACGGAGAA	TTAGGGTTCG
AG	CAAATTTCTG	CCCTATCAAC	TGTCGATGGT	AAGGTAGTGG	CTTACCATGG	TTACAACCGG	TGACGGAGAA	TTAGGGTTCG
CG	CAAATTTCTG	CCCTATCAAC	TGTCGATGGT	AAGGTAGTGG	CTTACCATGG	TTACAACCGG	TGACGGAGAA	TTAGGGTTCG
BR	CAAATTTCTG	CCCTATCAAC	TGTCGATGGT	AAGGTAGTGG	CTTACCATGG	TTACAACCGG	TGACGGAGAA	TTAGGGTTCG
CF	CAAATTTCTG	CCCTATCAAC	TGTCGATGGT	AAGGTAGTGG	CTTACCATGG	TTGGAACCGG	TGACGGAGAA	TTAGGGTTCG
SC	GTTCCGAGA	GGGAGCCTGA	GAAACGGCTA	CCACATCTAA	GGAAAGGCCG	AGGCACCGAA	ATTACCCAAT	CCCAATTCTGG
AL	ATTCCGAGA	GGGAGCCTGA	GAAACGGCTA	CCACATCTAA	GGAAAGGCCG	AGGGCCCAA	ATTACCCAAT	CTTGACTCAG
AS	ATTCCGAGA	GGGAGCCTGA	GAAACGGCTA	CCACATCTAA	GGAAAGGCCG	AGGGCCCAA	ATTACCCAAT	CTTGACTCAG
EJ	ATTCCGAGA	GGGAGCCTGA	GAAACGGCTA	CCACATCTAA	GGAAAGGCCG	AGGGCCCAA	ATTACCCAAT	CTTGACTCAG
RM	ATTCCGAGA	GGGAGCCTGA	GAAACGGCTA	CCACATCTAA	GGAAAGGCCG	AGGGCCCAA	ATTACCCAAT	CTTGACTCAG
TA	ATTCCGAGA	GGGAGCCTGA	GAAACGGCTA	CCACATCTAA	GGAAAGGCCG	AGGGCCCAA	ATTACCCAAT	CTTGACTTAG
FM	ATTCCGAGA	GGGAGCCTTA	GAGACGGCTA	CCACATCTAA	GGAAAGGCCG	AGGGCCCAA	ATTACCCAAT	CTTGACTCAG
AK	ATTCCGAGA	GGGAGCCTGA	GAGACGGCTA	CCACATCTAA	GGAAAGGCCG	AGGGCCCAA	ATTACCCAAT	CTTGACTCAG
LF	ATTCCGAGA	GGGAGCCTGA	GAAACGGCTA	CCACATCTAA	GGAAAGGCCG	AGGGCCCAA	ATTACCCAAT	CCCGACACGG
EC	ATTCCGAGA	GGGAGCCTGA	GAAACGGCTA	CCACATCTAA	GGAAAGGCCG	AGGGCCCAA	ATTACCCAAT	CTTGACGTGG
AG	ATTCCGAGA	GGGAGCCTGA	GAAACGGCTA	CCACATCTAA	GGAAAGGCCG	AGGGCCCAA	ATTACCCAAT	CTTGACGTGG
CG	ATTCCGAGA	GGGAGCCTGA	GAAACGGCTA	CCACATCTAA	GGAAAGGCCG	AGGGCCCAA	ATTACCCAAT	CTTGACGTGG
BR	ATTCCGAGA	GGGAGCCTGA	GAAACGGCTA	CCACATCTAA	GGAAAGGCCG	AGGGCCCAA	ATTACCCAAT	CTTGACGTGG
CF	ATTCCGAGA	GGGAGCCTGA	GAAACGGCTA	CCACATCTAA	GGAAAGGCCG	AGGCAACGAA	ATTACCCAAT	CC-GACTCGG
SC	GGAGGTAGTG	ACAAGAAATA	ACGATAACGGG	GTCTTCACAA-	GGTCTCGCAA	TGGAATGAG	TACAATTAA	ATC-CTTAA
AL	GGAGGTAGTG	ACAAGAAATA	ACAATACAGG	GCTTTTTTA-	AGTCTTGAA	TTGGAATGAG	TACAATTAA	AT-CCTTAA
AS	GGAGGTAGTG	ACAAGAAACTA	ACAATACAGG	GCTTTTTGA-	AGTCTTGAA	TTGGAATGAG	TACAATTAA	ATCC-TTTAA
EJ	GGAGGTAGTG	ACAAGAAATA	ACAATACAGG	GCTTTTCA-	AGTCTTGAA	TTGGAATGAG	TACAATTAA	ATCCTT-AA
RM	GGAGGTAGTG	ACAAGAAATA	ACAATACAGG	GCTTTTCA-	AGTCTTGAA	TTGGAATGAG	TACAATTAA	ATCCTTAA
TA	GGAGGTAGTG	ACAAGAAATA	ACAATACAGG	GCTTTTCA-	AGTCTTGAA	TTGGAATGAG	TACAATTAA	ATTCCTTAA
FM	GGAGGTAGTG	ACAAGAAATA	ACAATACAGG	GCTTTTCA-	AGTCTTGAA	TTGGAATGAG	TACAATTAA	ATCC-TTTAA
AK	GGAGGTAGTG	ACAAGAAATA	ACAATACAGG	GCTTTTCA-	AGTCTTGAA	TTGGAATGAG	TACAATTAA	ATCC-TTTAA
LF	GGAGGTAGTG	ACAAGAAATA	ACAATACAGG	GCTCTCTCG-	AGTCTTGAA	TTGGAATGAG	TACAATTAA	ATCTCTTAA
EC	GGAGGTAGTG	ACAAGAAATA	ACAATACAGG	GCTTTTTGT-	AGTCTTGAA	TTGGAATGAG	TACAATTAA	ATCTCTT-AA
AG	GGAGGTAGTG	ACAAGAAATA	ACAATACAGG	GCTTTTTGT-	AGTCTTGAA	TTGGAATGAG	TACAATTAA	ATCTCTT-AA
CG	GGAGGTAGTG	ACAAGAAATA	ACAATACAGG	GCTTTTTGT-	AGTCTTGAA	TTGGAATGAG	TACAATTAA	ATCTCTT-AA
BR	GGAGGTAGTG	ACAAGAAATA	ACAATACAGG	GCTTTTTGT-	AGTCTTGAA	TTGGAATGAG	TACAATTAA	ATCTCTT-AA
CF	GGAGGTAGTG	ACAAGAAATA	ACGGTACGGG	GTCTTGATA-	AGTCTCGAA	TTGGAATGAG	TACAATTGA	ATTAATTCT
SC	CGAGG-ATCC	AATGGAGGGC	AAAGTCTGGTG	CCAGCAGCGG	CGGTTAAC	CAGCTCATT	AGCGTATATT	AAAGTTGTTG
AL	CGAGG-ATCC	AATGGAGGGC	AAAGTCTGGTG	CCAGCAGCGG	CGGTTAAC	CAGCTCATT	AGCGTATATT	AAAGTTGTTG
AS	CGAGG-ATCC	ATTGGAGGGC	AAAGTCTGGTG	CCAGCAGCGG	CGGTTAAC	CAGCTCATT	AGCGTATATT	AAAGTTGTTG
EJ	CGAGG-AACC	ATTGGAGGGC	AAAGTCTGGTG	CCAGCAGCGG	CGGTTAAC	CAGCTCATT	AGCGTATATT	AAAGTTGTTG
RM	CGAGG-ATCC	ATTGGAGGGC	AAAGTCTGGTG	CCAGCAGCGG	CGGTTAAC	CAGCTCATT	AGCGTATATT	AAAGTTGTTG
TA	CGAGG-ATCC	ATTGGAGGGC	AAAGTCTGGTG	CCAGCAGCGG	CGGTTAAC	CAGCTCATT	AGCGTATATT	AAAGTTGTTG
FM	CGAGG-ATCC	ATTGGAGGGC	AAAGTCTGGTG	CCAGCAGCGG	CGGTTAAC	CAGCTCATT	AGCGTATATT	AAAGTTGTTG
AK	CGAGG-ATCC	ATTGGAGGGC	AAAGTCTGGTG	CCAGCAGCGG	CGGTTAAC	CAGCTCATT	AGCGTATATT	AAAGTTGTTG
LF	CGAGG-AACA	ATTGGAGGGC	AAAGTCTGGTG	CCAGCAGCGG	CGGTTAAC	CAGCTCATT	AGCGTATATT	AAAGTTGTTG
EC	CGAGG-ACCA	ATTGGAGGGC	AAAGTCTGGTG	CCAGCAGCGG	CGGTTAAC	CAGCTCATT	AGCGTATATT	AAAGTTGTTG
AG	CGAGG-ACCA	ATTGGAGGGC	AAAGTCTGGTG	CCAGCAGCGG	CGGTTAAC	CAGCTCATT	AGCGTATATT	AAAGTTGTTG
CG	CGAGG-ACCA	ATTGGAGGGC	AAAGTCTGGTG	CCAGCAGCGG	CGGTTAAC	CAGCTCATT	AGCGTATATT	AAAGTTGTTG
BR	CGAGG-ACCA	ATTGGAGGGC	AAAGTCTGGTG	CCAGCAGCGG	CGGTTAAC	CAGCTCATT	AGCGTATATT	AAAGTTGTTG
CF	TACGGCATCA	ATTGGAGGGC	AAAGTCTGGTG	CCAGCAGCGG	CGGTTAAC	CAGCTCATT	AGCGTATATT	AAAGTT-TTG
SC	CAGTTAAAAA	GCTCGTAGTT	GGATTTGGGT	GTGGGC-CAG	TGCGTCGCGC	GCAAGGCGT	TTACTGACTG	GTTCGCTCTT
AL	CAGTTAAAAA	GCTCGTAGTT	GGATTTGGGT	AT-GGCACGG	CCGGTCGCGC	GCAAGGCGT	CTACTGCCG	GGCTGCTCTT
AS	CAGTTAAAAA	GCTCGTAGTT	GGATTTGGGT	GT-GGCACGG	CCGGTCGCGC	GCAAGGCGT	CTACTGCCG	GGCGGCTCTT
EJ	CAGTTAAAAA	GCTCGTAGTT	GGATTTGGGT	AT-GGCACGG	CCGGTCGCGC	GCAAGGCGT	TTACTGCCG	AGCTGCTCTT
RM	CAGTTAAAAA	GCTCGTAGTT	GGATTTGGGT	AT-GGCACGG	CCGGTCGCGC	GCAAGGCGT	TTACTGCCG	AGCTGCTCTT
TA	CAGTTAAAAA	GCTCGTAGTT	GGATTTGGGT	AT-GGCACGG	CCGGTCGCGC	GCAAGGCGT	TTACTGCCG	AGCTGCTCTT
FM	CAGTTAAAAA	GCTCGTAGTT	GGATTTGGGT	AC-GGGTCGG	CCGGTCGCGC	GCGAGGCGT	TCACTGACCG	AGCTGCTCTT
AK	CAGTTAAAAA	GCTCGTAGTT	GGATTTGGGT	GT-GG-GCG-	CCGGTCGCGC	GCAAGGCGT	TCACTGCCG	GGCCGCTCTT
LF	CAGTTAAAAA	GCTCGTAGTT	GGATTTGGGT	CC-GGCCCCG	TTGGTACGCC	GCAAGGATATG	TCACTGCCG	GGCTGCTCTT
EC	CAGTTAAAAA	GCTCGTAGTT	GGATTTGGGT	CTCGACGCCG	ACGGCTACGCC	GCAAGGATATG	TCACTGTCGA	CGTTGGCCTT
AG	CAGTTAAAAA	GCTCGTAGTT	GGATTTGGGT	CTCGACGCCG	ACGGCTACGCC	GCAAGGATATG	TCACTGTCGA	CGTTGGCCTT
CG	CAGTTAAAAA	GCTCGTAGTT	GGATTTGGGT	CTCGACGCCG	ACGGCTACGCC	GCAAGGATATG	TXACTGTCGA	CGTTGGCCTT
BR	CAGTTAAAAA	GCTCGTAGTT	GGATTTGGGT	CTCGACGCCG	ACGGCTACGCC	GCAAGGATATG	CCACTGTCGA	CGTTGGCCTT
CF	CAGTTAAAAA	GCTCGTAGTT	GGATTTGGGT	ACGGGT-CAG	TOGGTCTGCC	GCAAGGATATG	TTACTGCCG	GCCTGCTCTT
SC	CTTCTCAAAG	AC-TGCCACGT	CCCCGCGCT	GGGTGTGTGT	ATGGATTTG	AGACGTTTAC	TTTGAACAAA	TTAGAGTGTGTT
AL	CTTCACAAAG	AC-TGCCGTGT	GCTCTTAAC	GAGTGTGCA-	-CAGGATTTG	TGACGTTTAC	TTTGAACAAA	TTAGAGTGTGTT
AS	CTTCACAAAG	AC-CCGTGT	GCTCTTAAC	GAGTGTGCA-	-GGG-AGTTG	CGACGTTTAC	TTTGAACAAA	TTAGAGTGTGTT
EJ	CCCCGCAAAG	ACCTGCGTGT	GCTCTTAAC	GAGTGTGCA-	-CAGGACGCT	CGACGTTTAC	TTTGAACAAA	TTAGAGTGTGTT
RM	CTTCACAAAG	AC-TGTGTGT	GCTCTTAAC	GAGTGTGCA-	-CAGGATCTG	CGACGTTTAC	TTTGAACAAA	TTAGAGTGTGTT
TA	CTTCACAAAG	AC-TGTGTGT	GCTCTTAAC	GAGTGTGCA-	-CAGGATCTG	CGACGTTTAC	TTTGAACAAA	TTAGAGTGTGTT
FM	CTTCACAAAG	AC-TCCGTGT	GCTCTTAAC	GAGTGTGCA-	-TAGGACTTG	CGACGTTTAC	TTTGAACAAA	TTAGAGTGTGTT
AK	CTTCACAAAG	ACT-CCGTGT	GCTCTTGACT	GAGTGTGCA-	-AGGTACTTG	CGACGTTTAC	TTTGAACAAA	TTAGAGTGTGTT

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LF	CTTCGCGAAG AC-TACGTGT GCTCTTAATT GAGTGTG-GG -TAGGATTG CGACGTTAC TTGAAAAAA TTAGAGTGT
EC	CTTCGCGAAG ACTT-CGGT GCTCTTAACT GAGTGTG-GT -T-GGATACG CGACGTTAC TTGAAAAAA TTAGAGTGT
AG	CCTCGCGAAG ACTT-CGGT GCTCTTAACT GAGTGTG-GT -T-GGATACG CGACGTTAC TTGAAAAAA TTAGAGTGT
CG	CTTCGCGAAG ACTT-CGGT GCTCTTAACT GAGTGTG-GT -C-GGATACG CGACGTTAC TTGAAAAAA TTAGAGTGT
BR	CTTCGCGAAG ACTT-CGGT GCTCTTAACT GAGTGTG-GT -T-GGATACG CGACGTTAC TTGAAAAAA TTAGAGTGT
CF	CTTCGCGAAG AC-TGCACAT GGCTCAAT- --GCACGTC GTAGGATTA CGACGTTAC TTGAAAAAA TTAGAGTGT
SC	CAAGGCAGGC TTTGAGGCTT GAATACATGA GCATGGAATA ATGGAATAGG ACCTCGGTCC C-TATTTCGT TGGTTTCAAG
AL	CAAAGCAGCC CA--GCCCTT GAATACATAA GCATGGAATA ATGGAATAGG ACTTTGGTTT TAATT--GT TGGTTTCTGG
AS	CAAAGCAGGC CA--GCCCTT GAATACATAA GCATGGAATA ATGGAATAGG ACTTTGGTTC TATTIT--GT TGGTTTCTGG
EJ	CAAAGCAGCC CA--GCCCTT GAATACATAA GCATGGAATA ATGGAATAGG ACTTTGGTTC TATTIT--GT TGGTTTCTGG
RM	CAAAGCAGCC CA--GCCCTT GAATACATAA GCATGGAATA ATGGAATAGG ACTTTGGTTC TATTIT--GT TGGTTTCTGG
TA	CAAAGCAGCC CA--GCCCTT GAATACATAA GCATGGAATA ATGGAATAGG ACTTTGGTTC TATTIT--GT TGGTTTCTGG
FM	CAAAGCAGGC CA--GCCCTT GAATACATAA GCATGGAATA ATGGAATAGG ACTTTGGTTC TATTIT--GT TGGTTTCTGG
AK	CAAAGCAGCC CA--GCCCTT GAATACATAA GCATGGAATA ATGGAATAGG ACTTTGGTTC TATTIT--GT TGGTTTCTGG
LF	CAAAGCA-GC TT--GCCCTT GAATACATAA GCATGGAATA ATGGAATAGG ACTTTGGTTC TAATT--GT TGGTTTGTAG
EC	CAAAGCAGGC TT--GTGCTT GGATACATAA GCATGGAATA ATGGAATAGG ACTTTGGTTC TATTITCGT TGGTTTCTGG
AG	CAAAGCAGGC TT--GTGCTT GGATACATAA GCATGGAATA ATGGAATAGG ACTTTGGTTC TATTITCGT TGGTTTCTGG
CG	CAAAGCAGGC TT--GTGCTT GGATACATAA GCATGGAATA ATGGAATAGG ACTTTGGTTC TATTITCGT TGGTTTCTGG
BR	CAAAGCAGGC TT--GTGCTT GGATACATAA GCATGGAATA ATGGAATAGG ACTTTGGTTC TATTITCGT TGGTTTCTGG
CF	CAAAGCAGC-T TAT--CGCTT GAATACATGA GCATGGAATA ATGGAATAGG ACTTTGGTTC T-TATTTTAT TGGTTTCTAG
SC	GA-CGAACT AATGATTAAG AGGGACAATT GGGG-CATCC GTATTTCGT GTCAGAGGTG AAATTCTTGG ACCTACGAAA
AL	AA-CGAACT AATGATTAAG AGGGACAGTT GGGGGCATTC GTATTTCGT GTCAGAGGTG AAATTCTTGG ATTTACGAAA
AS	AACCTGAACT AATGATTAAG AGGGACAGTT GGGGGCATTC GTATT-CGTT GTCAGAGGTG AAATTCTTGG ATTTACGAAA
EJ	AA-CCGXACT AATGATTTAG AGAGACAGTT GGGGGCATTC GTATTTCGT GTCAGAGGTG AAATTCTTGG ATTTACGAAA
RM	AA-CGAACT AATGATTAAG AGAGACAGTT GGGGGCATTC GTATTTCGT GTCAGAGGTG AAATTCTTGG ATTTACGAAA
TA	AA-CGAACT AATGATTCAG AGAGACAGTT GGGGGCATTC GTATTTCGT GTCAGAGGTG AAATTCTTGG ATTTACGAAA
FM	AA-CGAACT AATGATTTAA AGGGACAGTT GGGGGCATTC GTATTTCGT GTCAGAGGTG AAATTCTTGG ATTTACGAAA
AK	GAACCGAAGT AATGATTAAG AGGGACAGTT GGGGGCATTC GTATTTCGT GTCAGAGGTG AAATTCTTGG ATTTACGAAA
LF	AA-CCGAGGT AATGATTTAT AGGGACAGTT GGGGGCATTC GTATTTCGT GTCAGAGGTG AAATTCTTGG ATTTACGAAA
EC	AA-CGAACT AATGATTTAAT AGGGACAGTT GGGGGCATTC GTATTTCGT GTCAGAGGTG AAATTCTTGG ATTTACGAAA
AG	AA-CGAACT AATGATTTAAT AGGGACAGTT GGGGGCATTC GTATTTCGT GTCAGAGGTG AAATTCTTGG ATTTACGAAA
CG	AA-CGAACT AATGATTTAAT AGGGACAGTT GGGGGCATTC GTATTTCGT GTCAGAGGTG AAATTCTTGG ATTTACGAAA
BR	AA-CGAACT AATGATTTAAT AGGGACAGTT GGGGGCATTC GTATTTCGT GTCAGAGGTG AAATTCTTGG ATTTACGAAA
CF	AA-CGAACT AATGATTTAAT AGGGACAGTT GGGGGCATTC GTATTTCGT GTCAGAGGTG AAATTCTTGG ATTTACGAAA
SC	GACGAAACAA TCGGAAAGCA TTTGCCAAGA GTGTTTICAT TAATCAAGAA CGAAAGTTAG AGGATCGAAG ACGATCAGAT
AL	GACGAACTAC TCGGAAAGCA TTTGCCAAGA ATGTTTICAT TAATCAAGAA CGAAAGTTAG AGGCTCGAAG ACGATCAGAT
AS	GACGAACTAC TCGGAAAGCA TTTGCCAAGA ATGTTTICAT TAATCAAGAA CGAAAGTTAG AGGCTCGAAG ACGATCAGAT
EJ	GACGAACTAC TCGGAAAGCA TTTGCCAAGA ATGTTTICAT TAATCAAGAA CGAAAGTTAG AGGATCGAAG ACGATCAGAT
RM	GACGAACTAC TCGGAAAGCA TTTGCCAAGA ATGTTTICGT TAATCAAGAA CGAAAGTTAG AGGATCGAAG ACGATCAGAT
TA	GACGAACTAC TCGGAAAGCA TTTGCCAAGA ATGTTTICAT TAATCAAGAA CGAAAGTTAG AGGATCGAAG ACGATCAGAT
FM	GACGAACTAC TCGGAAAGCA TTTGCCAAGA ATGTTTICAT TAATCAAGAA CGAAAGTTAG AGGATCGAAG ACGATCAGAT
AK	GACGAACTAC TCGGAAAGCA TTTGCCAAGA ATGTTTICAT TAATCAAGAA CGAAAGTTAG AGGCTCGAAG ACGATCAGAT
LF	GACGAACTAA TCGGAAAGCA TTTGCCAAGA ATGTTTICAT TAATCAAGAA CGAAAGTTAG AGGATCGAAG ACGACCGAG
EC	GACGAACTAA TCGGAAAGCA TTTGCCAAGA ATGTTTICAT TAATCAAGAA CGAAAGTTAG AGGATCGAAG ACGATCAGAT
AG	GACGAACTAA TCGGAAAGCA TTTGCCAAGA ATGTTTICAT TAATCAAGAA CGAAAGTTAG AGGATCGAAG ACGATCAGAT
CG	GACGAACTAA TCGGAAAGCA TTTGCCAAGA ATGTTTICAT TAATCAAGAA CGAAAGTTAG AGGATCGAAG ACGATCAGAT
BR	GACGAACTAA TCGGAAAGCA TTTGCCAAGA ATGTTTICAT TAATCAAGAA CGAAAGTTAG AGGATCGAAG ACGATCAGAT
CF	GGCGGACAC TCGGAAAGCA TTTGCCAAGA GTGTTTICAT TAATCAAGAA CGAAAGTTAG AGGATCGAAG ACGATCAGAT
SC	ACCGTCTTAG TTCTAACCGT AAACGATGCC GACTAGGGAT CAGCGGCTGT TATTGTCGGA CCCCGTTGGC ACCTCACGG
AL	ACCGTCTTAG TTCTAACCAT AAACGATGCC GACTAGGGAT CAGAGGGTGT TATTGGATGA CCCCTTTGGC ACCTTATGGG
AS	ACCGTCTTAG TTCTAACCAT AAAACGATGCC GACTAGGGAT CAGAGGGTGT TATTGGATGA CCCCTTTGGC ACCTTATGGG
EJ	ACCGTCTTAG TTCTAACCAT AAAACGATGCC GACTAGGGAT CAGAGGGTGT TATTGGATGA CCCCTTTGGC ACCTTATGGG
RM	ACCGTCTTAG TTCTAACCAT AAACGATGCC GACTAGGGAT CAGAGGGTGT TATTGGATGA CCCCTTTGGC ACCTTATGGG
TA	ACCGTCTTAG TTCTAACCAT AAACGATGCC GACTAGGGAT CAGAGGGTGT TATTGGATGA CCCCTTTGGC ACCTTATGGG
FM	ACCGTCTTAG TTCTAACCAT AAACGATCCC GACTAGGGAT CAGAGGGTGT TATTGGATGA CCCCTTTGGC ACCTTATGGG
AK	ACCGTCTTAG TTCTAACCAT AAACGATCCC GACTAGGGAT CAGAGGGTGT TATTGGATGA CCCCTTTGGC ACCTTATGG-
LF	ACCGTCTTAG TTCTAACCAT AAACGATCCC GACTAGGGAT CAGAGGGTGT TATTGGATGA CCCCTTTGGC ACCTTATGGG
EC	ACCGTCTTAG TTCTAACCAT AAACGATCCC GACTAGGGAT CAGAGGGTGT TATTGGATGA CCCCTTTGGC ACCTTATGGG
AG	ACCGTCTTAG TTCTAACCAT AAACGATCCC GACTAGGGAT CAGAGGGTGT TATTGGATGA CCCCTTTGGC ACCTTATGGG
CG	ACCGTCTTAG TTCTAACCAT AAACGATCCC GACTAGGGAT CAGAGGGTGT TATTGGATGA CCCCTTTGGC ACCTTATGGG
BR	ACCGTCTTAG TTCTAACCAT AAACGATCCC GACTAGGGAT CAGAGGGTGT TATTGGATGA CCCCTTTGGC ACCTTATGGG
CF	ACCGTCTTAG TTCTAACCAT AAACGATCCC GACTAGGGAT CAGAGGGTGT TATTGGATGA CCCCTTTGGC ACCTTATGGG
	↓
SC	AAACCAAAGT GTTTGGGTTT CGGGGAAGT ATAGTCGAA CGCGGAAACT TAAAGGAATT GACCGAAGGG CACCAACCAGG
AL	AAACCAAAGT CTTTGGGTTT CGGGGAAGT ATGGTTGCAA AGCTGAAACT TAAAGGAATT GACCGAAGGG CACCAACCAGG
AS	AAACCAAAGT TTTTGGGTTT CGGGGAAGT ATGGTTGCAA AGCTGAAACT TAAAGGAATT GACCGAAGGG CACCAACCAGG
EJ	AAACCAAAGT TTTTGGGTTT CGGGGAAGT ATGGTTGCAA AGCTGAAACT TAAAGGAATT GACCGAAGGG CACCAACCAGG
RM	AAACCAAAGT TTTTGGGTTT CGGGGAAGT ATGGTTGCAA AGCTGAAACT TAAAGGAATT GACCGAAGGG CACCAACCAGG
TA	AAACCAAAGT TTTTGGGTTT CGGGGAAGT ATGGTTGCAA AGCTGAAACT TAAAGGAATT GACCGAAGGG CACCAACCAGG
FM	AAACCAAAGT TTTTGGGTTT CGGGGAAGT ATGGTTGCAA ATCTGAAACT TAAAGGAATT GACCGAAGGG CACCAACCAGG
AK	AAACCAAAGT TTTTGGGTTT CGGGGAAGT ATGGTTGCAA AGCTGAAACT TAAAGGAATT GACCGAAGGG CACCAACCAGG
LF	AAACCAAAGT TTTTGGGTTT CGGGGAAGT ATGGTTGCAA AGCTGAAACT TAAAGGAATT GACCGAAGGG CACCAACCAGG

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EC	AAACCAAAGT	TTTTGGGTTIC	CGGGGAAGT	ATGGATCAA	AGCTGAAACT	TAAAGGAATT	GACCGAAGGG	CACCAACAGG
AG	AAACCAAAGT	TTTTGGGTTIC	CGGGGAAGT	ATGGTTC	AGCTGAAACT	TAAAGGAATT	GACCGAAGGG	CACCAACAGG
CG	AAACCAAAGT	TTTTGGGTTIC	CGGGGAAGT	ATGGTTC	AGCTGAAACT	TAAAGGAATT	GACCGAAGGG	CACCAACAGG
BR	AAACCAAAGT	TTTTGGGTTIC	CGGGGAAGT	ATGGTTC	AGCTGAAACT	TAAAGGAATT	GACCGAAGGG	CACCAACAGG
CF	AAACCAAAGT	TTTTGGXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX
SC	AGTGGC--TG	CG-GCTTAAT	TTGACTCAAC	ACGGGAAAC	TCACCAGTC	CAGACATAGT	AAGGATTGAC	AGGTTGAGAG
AL	AGTGG-ACTG	CG-GCTTAAT	TTGACTCAAC	ACGGGAAAC	TCACCAGTC	CAGACATAGT	AAGGATTGAC	AGATTGAGAG
AS	AGTGG-AGCC	TGCGCTTAAT	TTGACTCAAC	ACGGGAAAC	TCACCAGTC	CAGACATAGT	AAGGATTGAC	AGATTGAGAG
EJ	AGTGG-ACTG	CG-GCTTAAT	TTGACTCAAC	ACGGGAAAC	TCACCAGTC	CAGACATAGT	GAGGATTGAC	AGATTGAGAG
RM	AGTGG-ACTG	CG-GCTTAAT	TTGACTCAAC	ACGGGAAAC	TCACCAGTC	CAGACGTAGT	AAGGATTGAC	AGATTGAGAG
TA	AGTGG-ACTG	CG-GCTTAAT	TTGACTCAAC	ACGGGAAAC	TCACCAGTC	CAGACATAGT	GAGGATTGTC	AGATTGAGAG
FM	AGTGG-ACTG	CG-GCTTAAT	TTGACTCAAC	ACGGGAAAC	TCACCAGTC	CAGACATAGT	GAGGATTGAC	AGATTGAGAG
AK	AGTGG-CATG	CG-GCTTAAT	TTGACTCAAC	ACGGGAAAC	TCACCAGTC	CAGACATAGT	AAGGATTGAC	AGATTGAGAG
LF	AGTGG-ACTG	CG-GCTTAAT	TTGACTCAAC	ACGGGAAAC	TCACCAGTC	CAGACATAGT	AAGGATTGAC	AGATTGAGAG
EC	AGTGG-ACTG	CG-GCTTAAT	TTGACTCAAC	ACGGGAAAC	TCACCAGTC	CAGACATAGT	AAGGATTGAC	AGATTGAGAG
AG	AGTGG-ACTG	CG-GCTTAAT	TTGACTCAAC	ACGGGAAAC	TCACCAGTC	CAGACATAGT	AAGGATTGAC	AGATTGAGAG
CG	AGTGG-ACTG	CG-GCTTAAT	TTGACTCAAC	ACGGGAAAC	TCACCAGTC	CAGACATAGT	AAGGATTGAC	AGATTGAGAG
BR	AGTGGCAGTG	CG-GCTTAAT	TTGACTCAAC	ACGGGAAAC	TCACCAGTC	CAGACATAGT	AAGGATTGAC	AGATTGAGAG
CF	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX
SC	CCCTTCTTG	ATTCTATGGG	TGGTGGTGC	TGGCGTTCT	TAGTTGGTGG	AGTGATTG	CTGGTTAATT	CCGATAACGA
AL	CTCTTCTTG	ATTCTATGGG	TGGTGGTGC	TGGCGTTCT	TAGTTGGTGG	AGTGATTG	CTGGTTAATT	CCGTTAACGA
AS	CTCTTCTTG	ATTCTATGGG	TGGTGGTGC	TGGCGTTCT	TAGTTGGTGG	AGTGATTG	CTGGTTAATT	CCGTTAACGA
EJ	CTCTTCTTG	ATTCTATGGG	TGGTGGTGC	TGGCGTTCT	TAGTTGGTGG	AGTGATTG	CTGGTTAATT	CCGTTAACGA
RM	CTCTTCTTG	ATTCTATGGG	TGGTGGTGC	TGGCGTTCT	TAGTTGGTGG	AGTGATTG	CTGGTTAATT	CCGTTAACGA
TA	CGCGTCTTG	ATTCTATGGG	TGGTGGTGC	TGGCGGCT	TAGTTGGTGG	AGTGATTG	CTGGTTAATT	CCGTTAACGA
FM	CTCTTCTTG	ATTCTATGGG	TGGTGGTGC	TGGCGTTCT	TAGTTGGTGG	AGTGATTG	CTGGTTAATT	CCGTTAACGA
AK	CTCTTCTTG	ATTCTATGGG	TGGTGGTGC	TGGCGTTCT	TAGTTGGTGG	AGTGATTG	CTGGTTAATT	CCGTTAACGA
LF	CTCTTCTTG	ATTCTATGGG	TGGTGGTGC	TGGCGTTCT	TAGTTGGTGG	AGTGATTG	CTGGTTAATT	CCGTTAACGA
EC	CTCTTCTTG	ATTCTATGGG	TGGTGGTGC	TGGCGTTCT	TAGTTGGTGG	AGTGATTG	CTGGTTAATT	CCGTTAACGA
AG	CTCTTCTTG	ATTCTATGGG	TGGTGGTGC	TGGCGTTCT	TAGTTGGTGG	AGTGATTG	CTGGTTAATT	CCGTTAACGA
CG	CTCTTCTTG	ATTCTATGGG	TGGTGGTGC	TGGCGTTCT	TAGTTGGTGG	AGTGATTG	CTGGTTAATT	CCGTTAACGA
BR	CTCTTCTTG	ATTCTATGGG	TGGTGGTGC	TGGCGTTCT	TAGTTGGTGG	AGTGATTG	CTGGTTAATT	CCGTTAACGA
CF	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXX--XX	TGTC-ATCGT
SC	ACGAGACCTT	GACCGCTAA	ATAGTTACG	AATTCTGAA	TTAGCAGCAA	TTCCAAGTA	ACTTCTTAGA	GGGACTGTTG
AL	ACGAGACCTT	AACTCTGAA	ATAGTTACG	GAATCTCGAT	TC-GTGGC-	------TA	ACTTCTTAGA	GGGACTGTTG
AS	ACGAGACCTT	AACTCTGAA	ATAGTTACG	CACTCGGAT	GG-GCAAC-	------TA	ACTTCTTAGA	GGGACTGTTG
EJ	ACGAGACCTT	AACTCTGAA	ATAGTTACG	GAATCCCGAT	TC-GTGGT-	------AA	ACTTCTTAGA	GGGACTGTTG
RM	ACGAGACCTT	AACTCTGAA	ATAGTTACG	GGATCCCGAT	TC-GCGGT-	------TA	ACTTCTTAGA	GGGACTGTTG
TA	ACGAGACCTT	AACTCTGAA	ATAGTTACG-C	GAATCCCGAT	TC-GCGGT-	------AA	ACTTCTTAGA	GGGACTGTTG
FM	ACGAGACCTT	AACTCTGAA	ATAGTTACG	CAATCCCGAT	TG-GCGGC-	------TA	ACTTCTTAGA	GGGACTGTTG
AK	ACGAGACCTT	AACTCTGAA	ATAGTTACG	C-GTCTCGAC	GG-GCCGC-	------TA	ACTTCTTAGA	GGGACTGTTG
LF	ACGAGACCTT	GTCTTGCTAA	ATAGTCTGGC	GATTCTGAA	TC-GTCCA-	------CG	ACTTCTTAGA	GGGACTGTTG
EC	ACGAGACCTT	GACCTGCTAA	ATAGTCAGAC	GATTCAAGAA	TC-GCTCT-	------CG	ACTTCTTAGA	GGGACTGTTG
AG	ACGAGACCTT	GACCTGCTAA	ATAGTCAGAC	GATTCAAGAA	TC-GCTCT-	------CG	ACTTCTTAGA	GGGACTGTTG
CG	ACGAGACCTT	GTCTTGCTAA	ATAGTCAGAC	GATTCAAGAA	TT-GCTCT-	------CG	ACTTCTTAGA	GGGACTGTTG
BR	ACGAGACCTT	GACCTGCTAA	ATAGTCAGAC	GATTCAAGAA	TC-GCTCT-	------CG	ACTTCTTAGA	GGGACTGTTG
CF	ACGACGACGA	GCTACGCTAA	-TAGTCAGC-	--ATCTCGAT	C-----GTGA	CT-----G	ACTC--TAGA	GG-ACTGTC--
SC	-GTGTTAAC	CAAAGAAAAGA	AAGGCAATAA	CAGGTCTGTG	ATGCC-TTA	GATGTTCTGG	GCCGCAOGCG	TGCTACACTG
AL	-GTGTTAAC	CAAAGTCAGG	AAGGCAATAA	CAGGGCTGTG	ATGCC-TTA	GATGTTCTGG	GCCGCAOGCG	OGCTACACTG
AS	-GTGTTAAC	CAAAGTCAGG	AAGGCAATAA	CAGGTCTGTG	ATGCC-TTA	GATGTTCTGG	GCCGCAOGCG	OGCTACACTG
EJ	-GTATCCAA	CAAAGTCAGG	AAGGCAATAA	CAGGTCTGTG	ATGCC-TTA	GATGTTCTGG	GCCGCAOGCG	OGCTACACTG
RM	-GTATCCAA	CAAAGTCAGG	AAGGCAATAA	CAGGGCTGTG	ATGCC-TTA	GATGTTCTGG	GCCGCAOGCG	OGCTACACTG
TA	-GTATCCAA	CAAAGTCAGG	AAGGCAATAA	CAGGGCTGTG	ATGCC-TTA	GATGTTCTGG	GCCGCAOGCG	OGCTACACTG
FM	-GTGTTAAC	CAAAGTCAGG	AAGGCAATAAG	CAGGGCTGTG	ATGCC-TTA	GATGTTCTGG	GCCGCAOGCG	OGCTACACTG
AK	-GTGTTAAC	CAAAGTCAGG	AAGGCAATAA	CAGGTCTGTG	ATGCC-TTA	GATGTTCTGG	-CGGGAOGCG	OGCTACACTG
LF	-GTGTTAAC	CAAAGTCAGG	AAGGCAATAA	CAGGGCTGTG	ATGCC-TTA	GATGTTCTGG	GCCGCAOGCG	OGCTACACTG
EC	CGTGTAAAC	CAAAGTCAGG	AAGGCAATAA	CAGGTCTGTG	ATGCC-TTA	GATGTTCTGG	GCCGCAOGCG	OGCTACACTG
AG	CGTGTAAAC	CAAAGTCAGG	AAGGCAATAA	CAGGTCTGTG	ATGCC-TTA	GATGTTCTGG	GCCGCAOGCG	OGCTACACTG
CG	CGTGTAAAC	CAAAGTCAGG	AAGGCAATAA	CAGGGCTGTG	ATGCC-TTA	GATGTTCTGG	GCCGCAOGCG	OGCTACACTG
BR	CGTGTAAAC	CAAAGTCAGG	AAGGCAATAA	CAGGTCTGTG	ATGCC-TTA	GATGTTCTGG	GCCGCAOGCG	OGCTACACTG
CF	-GTGTT--AC	--AGTCAGG	AAGGCAATAA	CAG-TCTGTG	ATGCC-TTA	GATGTTCTGG	-CGTCAOGCG	OGCTACACTG
SC	GTGAATACAG	CGAGTATCCA	TTCCCTTGAC	CGAAAAGGTCT	GGGTAATCTT	CTGAAA-GTT	CATCGTGCAC	GGGATTGATC
AL	ACGATGTCAA	CGAGTCTCT-	--CCTTCAC	CGATAGGTGT	GGGTAATCTT	GTGAAACA-T	CGTCGTGCTG	GGGATAGAGC
AS	ACGATGTCAA	CGAGTCTCT-	--CCTTCGG	CGAAAAGGTCT	GGGTAATCTT	CTCAAACA-T	CGTCGTGCTG	GGGATAGATC
EJ	ACGATGTCAA	AGAGTATCT-	--CCTTCAC	CGAGAGGTGT	GGGTAATCTT	TG-AAACA-T	CGTCGTGCTG	GGGATAGATT
RM	ACGATGTCAA	AGAGTCTCT-	--CCTTCAC	CGAGAGGTGT	GGGTAATCTT	GT-AAACA-T	CGTCGTGCTG	GGGATAGAAAT
TA	TCGATGTCAA	AGAGTATCT-	--CCTTCAC	CGCGAGGTGT	GGGGGATCTT	TT-AAACA-T	CGTCGTGCTG	GGGATAGAGC
FM	ACGACCTCAA	CGAGTCTCT-	--CCTTCGG	CGAATGGCGT	GGGTAATCTT	TTGAAACXGT	OTGTCGTGCTG	GGGATAGATT
AK	ACGATGTCAA	CGAGTCTCT-	--CCTTCGG	CGAAAGGTCT	GGGTAATCTT	ATGAAACA-T	CGTCGTGCTG	GGGATAGATC
LF	ATGATGTCAA	CGAGTCGGG	--CCTTCAC	CGAAAGGTGT	GGGTAATCTT	CTGTAATCA-T	CGTCGTGCTG	GGGATAGATC
EC	ACGATGCCAA	CGAGTCCT-	--CCTTCAC	CGAAAGGTGT	GGGTAATCTT	GTGAATCA-T	CGTCGTGCTG	GGGATAGATC

Systematic Relationship of Anthozoa

(continued)

AG	ACGATGCAA	CGAGTCGT-	---	CCTTCAC	CGAAAGGTGT	GGGTAAATCTT	GTGAATCA-T	CGTCGTGCTG	GGGATAGAXC
CG	TGGATGCAA	CGAGTCGC--	---	CCTTCAC	CGAAAGGTGT	GGGTGATCTT	CTCTATCA-T	CGXGTGCTG	GGGATAGAC
BR	ACGATGCAA	CGAGTCGT-	---	CCTTCAC	CGAAAGGTGT	GGGTAAATCTT	GTGAATCA-T	CGTCGTGCTG	GGGATAGATC
CF	TGGATTCTAG	CGAGTCCTAA	---	CCTTGAC	CGAAAGGTGT	GGGTAAATCTT	TTGAAA-GTC	CGACGTGATG	GG-ATTGATC
SC	ATTGCAATT	TTGATCATGA	ACGAGGAATT	OCTA--	GTAA	AGGGAGTC	TCATCTCGCT	TTGATTACGT	CCCTGCOCTT
AL	ATTGCAATT	TTGATCTTGA	ACGAGGAATT	OCTA--	GTAA	GGCGAGTC	TCAGCTCGG	TTGATTACGT	CCCTGCOCTT
AS	ATTGCAATT	TTGATCTTGA	ACGAGGAATT	OCTA--	GTAA	GGCGAGTC	TCAGCTCGG	TTGATTACGT	CCCTGCOCTT
EJ	ATTGCAATT	TTGATCTTGA	ACGAGGAATT	OCTA--	GTAA	GGCGAGTC	TCAGCTCGG	TTGATTACGT	CCCTGCOCTT
RM	ATTGCAATT	TTGATCTTGA	ACGAGGAATT	OCTA--	GTAA	GGCGAGTC	TCAGCTCGG	TTGATTACGT	CCCTGCOCTT
TA	ATTGCAATT	TTGATCTTGA	ACGAGGAATT	OCTA--	GTAA	GGCGAGTC	TCAGCTCGG	TTGATTACGT	CCCTGCOCTT
FM	ATTGCAATT	TTGATCTTGA	ACGAGGAATT	OCTA--	GTAA	GGCGAGTC	TCAGCTCGG	TTGATTACGT	CCCTGCOCTT
AK	ATTGCAATT	TTGATCTTGA	ACGAGGAATT	OCTA--	GTAA	GGCGAGTC	TCAGCTCGG	TTGATTACGT	CCCTGCOCTT
LF	ATTGTAATT	TTGATCTTGA	ACGAGGAATT	OCTA--	GTAA	GGCGAGTC	TCAGCTTGGG	TTGATTACGT	CCCTGCOCTT
EC	ATTGTAATT	TTGATCTTGA	ACGAGGAATT	OCTA--	GTAA	GGCGAGTC	TCAGCTCGG	TTGATTACGT	CCCTGCOCTT
AG	ATTGTAATT	TTGATCTTGA	ACGAGGAATT	OCTA--	GTAA	GGCGAGTC	TCAGCTCGG	TTGATTACGT	CCCTGCOCTT
CG	ATTGTAATT	TTGATCTTGA	ACGAGGAATT	OCTA--	GTAA	GGCGAGTC	TCAGCTCGG	TTGATTACGT	CCCTGCOCTT
BR	ATTGTAATT	TTGATCTTGA	ACGAGGAATT	OCTA--	GTAA	GGCGAGTC	TCAGCTCGG	TTGATTACGT	CCCTGCOCTT
CF	ATTGCAATT	TTGATCATGA	ACGAGGAATT	OCTAAGGTAA	ATGGAGTC	TCAGCTCGG	TTGATTACTG	CCCTGCOCTT	
SC	TGTACACACC	GCCCCGTGCT	ACTACCGATT	GAATGGTTTA	GTGAGATCTC	TGGATTGGCT	GCCTTGGTAC	CTTCACGGGT	
AL	TGTACACACC	GCCCCGTGCT	ACTACCGATT	GAATGGTTTA	GTGAGGCIT	CTTATTGGC-	GGCGOOGCCC	GGGAAACOGGA	
AS	TGTACACACC	GCCCCGTGCT	ACTACCGATT	GAATGGTTTA	GTGAGGACTC	CTGATTGGC-	GGCGC-GCCC	GGGCCACGGGA	
EJ	TGTACACACC	GCCCCGTGCT	ACTACCGATT	GAATGGTTTA	GTGAGGGCTT	CTTACTGTC-	GGCGCTATTTC	TGGCAACAGA	
RM	TGTACACACC	GCCCCGTGCT	ACTACCGATT	GAATGGTTTA	GTGAGGCCTT	CTTACTGTC-	GGCGATGCTC	TGGCAACACG	
TA	TGTACACACC	GCCCCGTGCT	ACTACCGATT	GAATGGTTTA	GTGAGGCTT	CTGACTGTC-	GGCGCTAC-C	TGGCAACAGA	
FM	TGTACACACC	GCCCCGTGCT	ACTACCGATT	GAATGGTTTA	GTGAGGACTT	CTTATTGGC-	GGCCGCCCGCC	GGGAAACOGGA	
AK	TGTACACACC	GCCCCGTGCT	ACTACCGATT	GAATGGTTTA	GTGAGGACTC	CTGATTGGC-	GGCGC-GCCC	GGGAAACOGGA	
LF	TGTACACACC	GCCCCGTGCT	ACTACCGATT	GAATGGTTTA	GTGAGGACTC	CGGATTCGGC-	GCTGTCGGAT	TGCA--AGA	
EC	TGTACACACC	GCCCCGTGCT	ACTACCGATT	GAATGGTTTA	GTGAGGC-TC	CGGATTGGC-	ACTGTCAGAT	GGGCTTOGGC	
AG	TGTACACACC	GCCCCGTGCT	ACTACCGATT	GAATGGTTTA	GTGAGGCTC	CGGATTGGC-	ACTGTCAGAT	GGGCTCOGGC	
CG	TGTACACACC	GCCCCGTGCT	ACTACCGATT	GAATGGTTTA	GTGAGGCTC	CGGATTGGC-	ACTGTCAGAT	GGGCTTOGGC	
BR	TGTACACACC	GCCCCGTGCT	ACTACCGATT	GAATGGTTTA	GTGAGGCTC	CGGATTGGC-	ACTGTCAGAT	GGGCTCOGGT	
CF	TGTACACACC	GCCCCGTGCT	ACTACCGATT	GAATGGTTTA	GTGAGATCTT	CGGATTGGC	OCTCGG---	TGGCTTATT	
SC	CCAACGGTT	A--GCCGAGA	ACGTGCT-CG	AACTTGATCA	TTT-AGAGGA	AGTAAAAGTC	GTAAACAAGGT	TTCCGTAGGT	
AL	GTAGGGAT-	--GXCCGAGA	AGTTGGT-TA	AAATTGATA	TTT-AGAGGA	AGTAAAAGTC	GTAAACAAGGT	TTCCGTAGGT	
AS	GCAGCGGAC-	--TGCAGGAGA	AGTTG-TTCA	AACTTGATCA	TTT-AGAGGA	AGTAAAAGTC	GTAAACAAGGT	TTCCGTAGGT	
EJ	GGCGTGGAC-	--TGCAGGAGA	AGTTGGT-CA	AACTTGATCA	TTT-AGAGGA	AGTAAAAGTC	GTAAACAAGGT	TTCCGTAGGT	
RM	GGCCCGGA-	--TGCAGGAGA	AGTTGGTCA	AACTTGATCA	TTT-AGAGGA	AGTAAAAGTC	GTAAACAAGGT	TTCCGTAGGT	
TA	GGCCCGGA-	--T-TCGGGA	AGTTGG-GGA	AGCTTGGAT	TTT-AGAGGA	AGTAAAAGTC	GTAAACAAGGT	TTCCGTAGGT	
FM	GTAGGGAT-	--GXCCGAGA	AGTTGGT-TA	AAATTGATA	TTT-AGAGGA	AGTAAAAGTC	GTAAACAAGGT	TTCCGTAGGT	
AK	GCAGCGGAA-	--TGCAGGAGA	AGTTG-TTCA	AACTTGATCA	TTT-AGAGGA	AGTAAAAGTC	GTAAACAAGGT	TTCCGTAGGT	
LF	T--TCTGACG	GAGGCCAGA	AGTTGGT-TT	AACTTGACCA	TTTATAGGG	AGTAAAAGTC	GTAAACAAGGT	TTCCGTAGGT	
EC	CCATCCGACG	GACGTCAAAA	AGTTGGT-CA	AACTTGATCA	TTT-AGAGGA	AGTAAAAGTC	GTAAACAAGGT	TTCCGTAGGT	
AG	CCATCCGACG	GACGTCAAAA	AGTTGGT-CA	AACTTGATCA	TTT-AGAGGA	AGTAAAAGTC	GTAAACAAGGT	TTCCGTAGGT	
CG	TCATCCGACG	GACGTCAAAA	AGTTGGT-CA	AACTTGATCA	TTT-AGAGGA	AGTAAAAGTC	GTAAACAAGGT	TTCCGTAGGT	
BR	TCATCCGACG	GACGTCAAAA	AGTTGGT-CA	AACTTGATCA	TTT-AGAGGA	AGTAAAAGTC	GTAAACAAGGT	TTCCGTAGGT	
CF	GCTGT-GCTG	G--GTCGAAA	AGTTGAT-CA	AACTTGATCA	TTT-AGAGGA	AGTAAAAGTC	GTAAACAAGGT	TTCCGTAGGT	
SC	GAAC-TGCGG	CGGGATT-AT	TA						
AL	GAAC-TGCGG	GAGGGXTCAT	TA						
AS	GAACCTCGGG	AAGGA-TCAT	TA						
EJ	GAAC-TGCGG	GAGGGXTCTT	TA						
RM	GAAC-TGCGG	AAGGATCATT	AA						
TA	GAAC-TGCGG	AAGGGTCTAT	TA						
FM	GAAC-TGCGG	AAGGATTAAT	TA						
AK	GAACCTCGGG	AAGGA-TCAT	TA						
LF	GAACTXCGG	AGGGATCA-T	TA						
EC	GAAC-TGCGG	AAGGA-TAAT	AA						
AG	GAAC-TGCGG	GAGGAACAAT	TA						
CG	GAAC-TGCGG	GAGGAACAAT	AA						
BR	GAACCTCGGG	AAGGATCA-T	TA						
CF	GAAC-TGCGG	GAAGGATCAT	TA						