

**Figure 1. Initial NJ Tree Based on Pinniped\_initdata.txt**

**Table 1.** Table linking FASTA files to genomic locations

| Common Name/Identifier | Accession Number | COX1 Sequence Position Range |
|------------------------|------------------|------------------------------|
| Harbor Seal            | NC_001325.1      | 6275-7819                    |
| Caspian Seal           | NC_008431.1      | 5344-6888                    |
| Harp Seal              | NC_008429.1      | 5341-6885                    |
| Leopard Seal           | NC_008425.1      | 5351-6895                    |
| Elephant Seal          | NC_008422.1      | 5353-6897                    |
| Crabeater Seal         | NC_008423.1      | 5352-6896                    |
| N Fur Seal             | NC_008415.3      | 5352-6896                    |
| SA Fur Seal            | NC_063561.1      | 5354-6898                    |
| Walrus                 | NC_004029.2      | 5350-6894                    |
| House Cat              | NC_001700.1      | 6216-7760                    |
| Dog                    | NC_002008.4      | 5349-6893                    |
| Aus Sea Lion           | NC_008419.1      | 5360-6904                    |
| Cali Sea Lion          | NC_008416.1      | 5358-6902                    |
| Caribbean Manatee      | NC_010302.1      | 5336-6877                    |
| Steller's Sea Cow      | NC_040161.1      | 2942-4483                    |
| Asiatic Elephant       | NC_005129.2      | 5329-6879                    |
| Cape Rock Hyrax        | NC_004919.1      | 5332-6872                    |
| American Alligator     | NC_001922.1      | 5314-6868                    |
| Chicken                | NC_053523.1      | 5419-6969                    |

**New MSA Including Additional Sequences**

Please refer to end of document.

**Script to Produce ML Phylogenetic Tree**

```
#Create new MSA with new sequences and save MSA
```

```
new_data <- readDNASTringSet("new_msa_data.txt")
```

```
new_msa <- msa(new_data)
```

```
sink(file = "new_msa_output.txt")
```

```
print(new_msa, show="complete")
```

```
sink()
```

```
#Format new MSA
```

```
new_msa_phyDat <- as.phyDat(new_msa)
```

```
#Maximum likelihood analysis: Model selection
```

```
mt <- modelTest(new_msa_phyDat, model=c("JC", "F81", "K80", "HKY", "SYM", "GTR"))
```

```
mt
```

```
which.min(mt$BIC)
```

```
env = attr(mt, "env")
```

```
bestmodel <- mt$Model[which.min(mt$BIC)]
```

```
fitStart = eval(get(bestmodel, env), env)
```

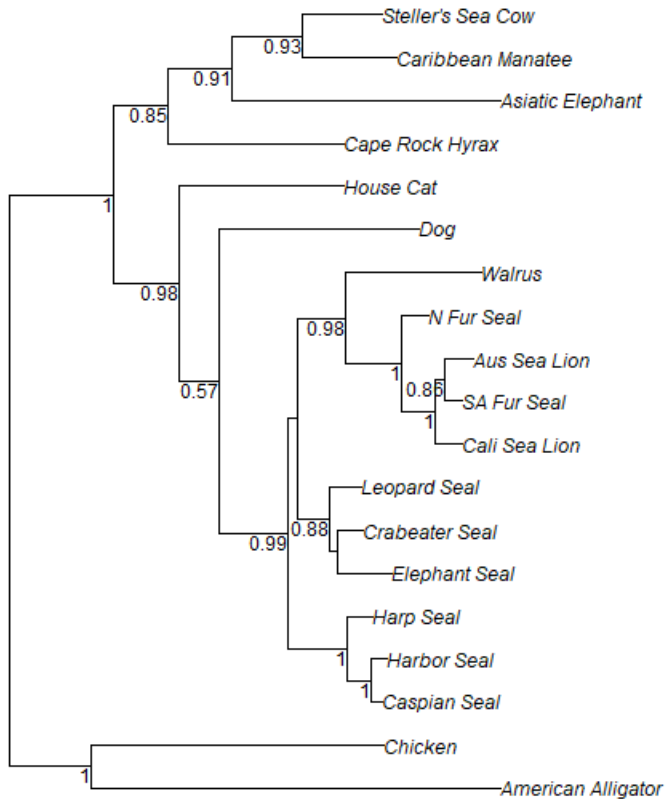
```
fit = optim.pml(fitStart, rearrangement = "stochastic",  
               optGamma = TRUE, optInv = TRUE, bestmodel)
```

```
fit
```

```
#Maximum likelihood analysis: Bootstrap
```

```
bs <- bootstrap.pml(fit, bs=100, optNni=TRUE)
```

```
plotBS(midpoint(fit$tree), bs, p = 0.5, type="p", cex = 0.6)
```



**Figure 2. ML Phylogenetic Tree from Own Dataset**

### Discussion on Evolutionary Model and Branch Support

The best fit evolutionary model based on the AICs is GTR+G(4)+I since it is the model with the lowest BIC (~24830). Based on the generated tree above, most branches are well supported due to the high bootstrap confidence values (>0.85). However, the only exception is the branch separating *Dog* from various seals with a relatively low bootstrap confidence (0.57).

### Questions

**A)** The first event of terrestrial ancestors adapting to a marine environment occurs at the 0.91 branch involving a split between the *Asiatic Elephant* and *Steller's Sea Cow* and *Caribbean Manatee*, which is a single event. The other event involves the 0.57 branch split between *Dog* and various seals, walrus, and sea lions, which also occurs as a single event. Therefore, yes, manatees share a common evolutionary origin with seals in adapting to a marine environment since both groups had undergone a single event involving a split from a terrestrial group (i.e., manatees with elephant vs. seals with dogs).

**B)** Yes, the *Caspian seal*, *Harbor seal*, and *Harp seal* are a monophyletic group since this grouping includes their ancestor (the 1 branch split between *Harp seal* vs. *Harbor* and *Caspian seal*) and all its descendants.

**C)** No, the fur seals are not a monophyletic group since this grouping does not include the ancestor (the 1 branch split between N Fur Seal vs. other seals) and all its descendants. The monophyletic group would also include the Aus Sea Lion and Cali Sea Lion, but since it does not, the fur seals are a polyphyletic group.

**D)** No, walrus are not distinct from the other seal groups since they are more closely related to one of the seal groups (fur seals and sea lions) than the other seal groups. For walrus to be considered distinct, there would have to be a split between walrus vs. *all* seal groups.

**E)** Yes, the results are broadly consistent with the results in Fig. 1 of Arnason 2006. All variants of seals and sea lions are most closely related, with walrus most closely related to sea lions. From there, all seals, sea lions, and walrus are then most closely related to dog, then cat, and least closely related to the outgroups. There does not appear to be any exceptions or major deviations between the two trees.

**F)** As mentioned previously, most branches are well supported with high bootstrap confidences, except for the 0.57 branch that splits Dog vs. sea lions, seals, and walrus. Several methods to improve this may include improving data quality by performing a multiple gene analysis, compare results with other phylogenetic methods (ex. neighbour-joining), compare with other independent data sources (ex. morphological or ecological data), etc.

**G)** Based on quantitative measurements from a ruler to estimate branch lengths, the dog-cat split is ~4cm from today, which indicates that 4cm = 52 million years ago. To determine how many cm represents 1 million years,  $4 \text{ cm} / 52 = 0.1 \text{ cm}$ . Thus, every 0.1 cm = 1 million years. For the walrus, it occurs at approximately 1.5 cm from today, so  $1.5 \text{ cm} / 0.1 \text{ cm} = 15$ , and thus the walrus split with sea lions and fur seals occurred ~15 million years ago. For manatees, the split occurs at approximately 2cm from today, so  $2 \text{ cm} / 0.1 \text{ cm} = 20$ , and thus the manatee split with the Steller's Sea Cow occurred ~20 million years ago.

### New MSA Including Additional Sequences

MsaDNAMultipleAlignment with 19 rows and 1558 columns

| aln (1..106)                                                                       | names        |
|------------------------------------------------------------------------------------|--------------|
| [1]                                                                                | ---          |
| ATGTTTCATAAATCGATGGTTATTTTCCACAAATCATAAGGATATCGGCACTCTTTATTTGCTGTTTGGCGCATGAGCTGG  |              |
| AATAGTAGGCACCGCCCTCAGTC                                                            | Harbor_Seal  |
| [2]                                                                                | ---          |
| ATGTTTCATAAATCGATGGTTATTTTCCACAAATCATAAGGATATTGGCACTCTTTATTTGCTGTTTGGCGCATGAGCTGG  |              |
| AATGGTAGGCACCGCCCTTAGTC                                                            | Caspian Seal |
| [3]                                                                                | ---          |
| ATGTTTCATAAATCGATGGTTATTTTCCACAAATCATAAAGATATCGGTACTCTTTACTTACTGTTTCGGTGCATGGGCTGG |              |
| CATGGTAGGCACCGCTCTTAGTC                                                            | Harp Seal    |
| [4]                                                                                | ---          |
| ATGTTTCATAAACCGATGACTATTTTCCACAAACCATAAAGATATTGGTACTCTCTATCTATTATTTGGTGCATGAGCCGG  |              |
| TATAGTAGGTACCGCCCTCAGTC                                                            | Leopard Seal |

[5] ---  
ATGTTTCATAAAATCGATGGCTATTTTCCACAAATCACAAAGATATTGGCACTCTCTACCTACTATTTCGGTGCATGAGCCGG  
CATAGTAGGTACCGCCCTCAGTC Crabeater Seal

[6] ---  
ATGTTTCGTAAATCGATGACTATTCTCTACAAATCATAAAGACATCGGCACTCTCTACCTATTATTGGTGCATGAGCCGG  
CATAGTAGGCACCGCCCTCAGTC Elephant Seal

[7] ---  
ATGTTTCGTAAATCGATGATTATTCTCCACAAACCATAAAGATATTGGCACCCCTTTATCTACTATTTCGGTGCATGAGCTGG  
AATGGCTGGCACCGCCCTCAGCC SA Fur Seal

[8] ---  
ATGTTTCGTAAATCGATGATTATTCTCTACAAACCATAAAGATATTGGCACCCCTCTATCTACTATTTCGGTGCATGAGCCGG  
AATAGCTGGCACCGCCCTCAGCC Aus Sea Lion

[9] ---  
ATGTTTCGTAAATCGATGATTATTCTCTACAAACCATAAAGATATTGGCACCCCTCTATTACTATTGGTGCATGAGCTGG  
AATGGCTGGCACCGCTCTCAGCC Cali Sea Lion

... ..

[12] ---  
ATGTTTCATAAACCGGTGACTATTTTCAACTAATCACAAAGATATTGGTACTCTTTACCTTTTATTCGGTGCCTGAGCTGG  
CATGGTGGGGACTGCTCTTAGTC House Cat

[13] ---  
ATGTTTCATTAACCGATGACTGTTCTCCACTAATCACAAAGATATTGGTACTTTATACTTACTATTTGGAGCATGAGCCGG  
TATAGTAGGCACTGCTTTGAGCC Dog

[14] ---  
ATGTTTCATCAATCGTTGATTATTCTCAACCAATCACAAAGATATTGGCACCCCTGTATTTACTATTTCGGCGCTTGAGCCGG  
AATGGTAGGAACTGCTCTGAGCA Caribbean Manatee

[15] ---  
ATGTTTCATTAACCGTTGACTGTTTTCAACTAACCATAAAGACATTGGAACCTCTGTACCTGCTATTTGGCGCTTGAGCCG  
GAATAGTAGGGACTGCCCTAAGTA Steller's Sea Cow

[16] ---  
ATGTTTGCTAACCGCTGACTATATTCAACAAACCACAAAGATATTGGAACACTGTATCTACTATTTGGTGCTTGAGCTG  
GTATAGTAGGGACTGCTTTTAGTA Asiatic Elephant

[17] ---  
ATGTTTCATCAACCGTTGATTGTTTTCAACCAACCATAAAGACATCGGCACTTTGTACTTACTATTTGGAGCTTGAGCTG  
GAATAGTAGGAACCGCCCTAAGCA Cape Rock Hyrax

[18] ---  
GTGAACTTCC---  
ACCGTTGACTCTTCTCTACTAACCACAAAGACATTGGCACCCCTTTACTTCATTTTCGGAACCTTGAGCCGGAATGGTGG  
GAACAGCACTTAGCC American Alligator

[19]

GTGACCTTCATCAACCGATGATTATTCTCAACCAACCACAAAGACATTGGCACTCTTTACCTAATTTTCGGCACATGGG  
CGGGCATAGCCGGCACAGCACTTAGCC Chicken

Con

---

ATGTTCATAAATCGATGATTATTCTC?ACAAACCATAAAGATATTGGCACTCT?TACCTACTATTTGGTGCATGAGC?GG  
AATAGTAGGCACCGCCCT?AGCC Consensus

aln (107..212)

names

[1]

TCTTAATCCGCGCAGAACTAGGACAACCTGGCGCCCTACTAGGAGATGACCAAATTTACAACGTAATTGTCACCGCCC  
ATGCATTCGTAATAATTTTCTTCATGGT Harbor\_Seal

[2]

TCTTAATCCGCGCAGAACTAGGACAACCTGGCGCCCTACTAGGAGATGACCAAATTTACAACGTAATTGTCACCGCCC  
ATGCATTTGTAATAATTTTCTTCATAGT Caspian Seal

[3]

TCTTAATCCGCGCAGAACTAGGACAACCTGGTGCCCTACTAGGAGATGACCAAATTTACAATGTAATTGTCACCGCCC  
ATGCATTTGTAATAATTTTCTTTATAGT Harp Seal

[4]

TTTTAATTCGCGCAGAACTAGGACAACCTGGTGCCCTGCTAGGAGACGATCAGATCTATAACGTGATTGTCACCGCCC  
ACGCATTCGTAATAATCTTCTTCATAGT Leopard Seal

[5]

TTTTAATTCGCGCAGAACTAGGACAACCTGGCGCTTTACTAGGAGACGACCAAATTTATAACGTGATCGTCACCGCCC  
ACGCATTCGTAATAATCTTTTTTATAGT Crabeater Seal

[6]

TTTTAATTCGCGCAGAACTAGGGCAGCCTGGCGCTTTACTAGGAGACGATCAGATCTATAACGTGATTGTCACCGCTC  
ACGCATTCGTAATAATCTTTTTTATAGT Elephant Seal

[7]

TATTGATCCGCGCGGAGTTGGGCCAACCAGGCACTCTACTAGGAGATGACCAAATCTACAACGTAATTGTCACCGCCC  
ATGCATTCGTAATAATCTTTTTCATGGT SA Fur Seal

[8]

TATTGATCCGCGCGGAGTTAGGCCAACCAGGCACTCTACTAGGAGATGACCAAATCTACAACGTAATTGTCACCTGCC  
ACGCATTCGTAATAATCTTCTTCATGGT Aus Sea Lion

[9]

TATTAATCCGCGCGGAATTAGGCCAACCAGGCACCCTACTAGGGGACGACCAAATCTACAATGTAATTGTCACCGCCC  
ATGCATTCGTAATAATCTTTTTCATAGT Cali Sea Lion

... ..

[12]

TTCTAATCCGGGCCGAACCTGGTACACTACTAGGAGATGATCAGATTACAATGTAATCGTCACTGCCC  
ATGCTTTTGAATGATCTTTTTATGGT House Cat

[13]

TCCTCATCCGAGCCGAACCTAGGTCAGCCCGGTACTTTACTAGGTGACGATCAAATTTATAATGTCATCGTAACCGCCCC  
TGCTTTCGTAATAATCTTCTTCATAGT Dog

[14]

TTCTAATTCGGGCCGAATTAGGCCAGCCCGGCACCTCCTGGGAGATGATCAAATCTACAATGTCATCGTAACAGCCC  
ATGCCTTCGTAATAATTTTCTTCATGGT Caribbean Manatee

[15]

TCTTAATTCGAGCTGAATTGGGTCAACCAGGCACTCTCCTAGGAGACGACCAAATCTATAACGTTATCGTAACGGCCC  
ATGCTTTCGTAATAATTTTCTTCATAGT Steller's Sea Cow

[16]

TTCTAATTCGGGCAGAATTAGGTCAACCAGGCTCTCTTCTTGGAGACGACCAAATCTATAATGTCATTGTCACAGCAC  
ACGCCTTGTGAATAATCTTCTTTATAGT Asiatic Elephant

[17]

TCCTAATCCGGGCCGAACCTCGGCCAACCAGGAGCCCTACTGGGAGATGATCAAATCTACAACGTTGTAGTTACAGCT  
CACGCATTTGAATAATTTTCTTCATAGT Cape Rock Hyrax

[18]

TCCTTATTCGGACAGAATTAAGCCAGCCCGGACCTCTATTAGGTGATGACCAAATTTATAACGTAATTGTCACCGCCCCA  
TGCCTTCATTATAATCTTTTTTATAGT American Alligator

[19]

TTCTAATTCGCGCAGAACTAGGACAGCCCGGAACCTCTTAGGAGACGATCAAATTTACAATGTAATCGTCACAGCCC  
ATGCTTTCGTCATAATCTTCTTTATAGT Chicken

Con

T?TTAATCCGCGCAGAACTAGG?CAACC?GGCACTCTACTAGGAGACGACCAAATCTACAACGTAATTGTCACCGCCC  
ATGCATTCGTAATAATCTTCTTCATAGT Consensus

aln (213..318)

names

[1]

AATGCCCATCATAATTGGCGGCTTTGGGAACTGACTGGTGCCCTAATAATTGGAGCTCCTGATATAGCATTCCCCCGA  
ATAAATAACATAAGTTTCTGACTTTTA Harbor\_Seal

[2]

AATGCCCATCATAATTGGGGGCTTTGGGAACTGACTAGTGCCCTAATAATTGGAGCTCCTGATATAGCATTCCCCCGA  
ATAACAACATAAGTTTCTGACTCTTA Caspian Seal

[3]

AATGCCTATTATAATTGGCGGGTTTGGGAACTGATTAGTACCCCTGATAATCGGAGCCCCTGATATAGCATTTCCTCGAA  
ATAAATAATATAAGTTTCTGACTTTTA Harp Seal

[4]

AATACCTATCATAATCGGAGGCTTCGGAACTGATTAGTACCCCTAATAATCGGCGCTCCTGACATGGCATTCCCCCGA  
ATAACAATATAAGCTTCTGACTCCTT Leopard Seal

[5]

AATACCTATCATAATCGGAGGCTTCGGAACTGATTAGTACCCCTAATAATTGGTGCTCCTGACATAGCATTTCCTCGAA  
TAAATAATATGAGCTTCTGACTTCTA Crabeater Seal

[6]

AATACCTATCATGATCGGAGGTTTCGGAACTGGTTAGTACCTCTAATGATTGGTGCCCCTGACATAGCATTTCCTCGAA  
ATAAATAATATAAGCTTCTGACTTCTA Elephant Seal

[7]

AATACCTATTATAATTGGGGGCTTTGGAAATTGATTAGTACCCCTAATAATTGGAGCCCCGATATGGCATTTCCTCGAA  
TAAATAACATAAGTTTCTGACTTCTA SA Fur Seal

[8]

AATACCTATTATAATTGGAGGCTTCGGAAATTGATTGGTGCCCCTGATAATTGGAGCTCCCGACATGGCATTTCCTCGAA  
ATAACAACATAAGTTTCTGACTTCTA Aus Sea Lion

[9]

AATGCCTATTATGATTGGAGGCTTTGGAAATTGATTAGTACCCCTAATAATTGGTGCTCCCGACATGGCATTTCCTCGAA  
ATAACAACATAAGTTTCTGACTTCTA Cali Sea Lion

... ..

[12]

GATGCCTATTATAATTGGAGGTTTCGGAACTGATTGGTCCCCTAATAATTGGAGCTCCTGACATAGCATTTCCTCGAA  
ATAACAACATGAGCTTCTGACTCCTC House Cat

[13]

CATGCCCATCATAATTGGGGGCTTTGGAACTGACTAGTGCCGTTAATAATTGGTGCTCCGGACATGGCATTCCCCCG  
AATAAATAACATGAGCTTCTGACTCCTT Dog

[14]

TATGCCCATCATAATCGGAGGATTTGGGAACTGACTAGTCCCTCTAATAATTGGAGCCCCGACATGGCGTTCCCCCG  
AATAAATAATGAGCTTCTGACTCCTA Caribbean Manatee

[15]

AATACCTATTATGATTGGAGGCTTTGGAAATTGGTTGGTCCCTTTAATAATTGGAGCACCTGACATGGCTTTCCCCCG  
ATAAATAACATGAGCTTCTGACTCTTA Steller's Sea Cow

[16]

TATGCCAATCATAATTGGAGGCTTTGGAACTGGTTAATTCCACTTATAATTGGAGCACCTGATATAGCTTTTCCTCGAA  
TAAACAATATAAGTTTCTGACTACTG Asiatic Elephant



[17]

AATGCCAATTATAATCGGAGGGTTCGGCAACTGACTAGTCCCCTTAATAATTGGCTCCCCGGATATAGCATTCCCACGA  
ATAACAACATGAGCTTCTGACTATTA Cape Rock Hyrax

[18]

AATACCAATTATAATTGGAGGGTTTGGAAACTGGCTATTACCCCTAATAATCGGAGCCCCAGACATGGCATTCCCCCGA  
ATAACAACATAAGTTTCTGATTACTC American Alligator

[19]

TATACCCATCATGATCGGTGGCTTCGGAAACTGACTAGTCCCCTTATAATCGGTGCCCCAGACATAGCATTCCCCCGC  
ATAAATAACATAAGCTTCTGACTCCTC Chicken

Con

AATACCTATCATAATTGGAGGCTTTGGAAACTGATTAGT?CCCCTAATAATTGGAGC?CC?GACATAGCATTCCCCGA  
ATAACAACATAAGCTTCTGACT?CTA Consensus

aln (319..424)

names

[1]

CCACCGTCCTTCTACTACTACTGGCCTCCTCTATAGTAGAAGCAGGTGCCGGAACCGGGTGAACCGTTTATCCTCCCC  
TAGCTGGGAACCTGGCTCATGCAGGAG Harbor\_Seal

[2]

CCACCATCCTTCTACTACTACTGGCCTCCTCTATAGTAGAAGCAGGTGCCGGGACCGGGTGAACCGTTTATCCTCCCC  
TAGCTGGGAACCTGGCTCATGCAGGGG Caspian Seal

[3]

CCACCATCCTTCTATTACTACTGGCCTCCTCTATAGTAGAAGCGGGTGCCGGAACCTGGATGAACCTGTCTATCCTCCCT  
TAGCTGGTAATCTAGCTCATGCAGGAG Harp Seal

[4]

CCACCATCTTCTCTACTACTACTAGCTTCATCCATAGTAGAAGCAGGTGCAGGAACAGGATGGACTGTGTATCCTCCCT  
TAGCTGGTAACCTAGCTCATGCAGGAG Leopard Seal

[5]

CCACCATCCTTCTTATTACTACTAGCTTCTCCATGGTAGAAGCAGGTGCAGGAACAGGATGAACCGTATATCCTCCCT  
TAGCTGGCAATCTAGCTCATGCAGGAG Crabeater Seal

[6]

CCACCATCCTTCTATTACTATTAGCTTCTCCATAGTAGAAGCAGGTGCAGGAACAGGATGAACCGTCTATCCCCCTC  
TAGCTGGTAACCTAGCCCATGCAGGAG Elephant Seal

[7]

CCCCCTCCTTCTACTACTACTAGCCTTCTCTAGTTGAAGCCGGCGCAGGTACCGGATGAACAGTTTACCCTCCCC  
TAGCAGGAAACCTAGCCCATGCAGGAG SA Fur Seal

[8]

CCCCCTCCTTCCTACTACTACTAGCCTCTTCCTAGTTGAAGCCGGCGCAGGTACCGGATGAACGGTTTACCCTCCCC  
TAGCAGGGAACCTAGCCACGCAGGGG Aus Sea Lion

[9]

CCCCCTCCTTTCTACTACTACTAGCCTCTTCTAGTTGAAGCCGGCGCGGGTACCGGATGAACGGTTTATCCTCCCC  
TAGCAGGGAATCTAGCCCATGCGGGAG Cali Sea Lion

... ..

[12]

CCTCCATCCTTTCTACTCTTACTCGCCTCATCTATGGTAGAAGCCGGAGCAGGAAGTGGGTGAACAGTATACCCACCCC  
TAGCCGGCAACCTGGCTCATGCAGGAG House Cat

[13]

CCTCCATCCTTTCTTCTACTATTAGCATCTTCTATGGTAGAAGCAGGTGCAGGAACGGGATGAACCGTATACCCCCAC  
TGGCTGGCAATCTGGCCCATGCAGGAG Dog

[14]

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TAGCTGGGAACCTAGCCCATGCCGGAG Caribbean Manatee

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TAGCAGGAAACTTAGCTCACGCCGGAG Steller's Sea Cow

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TGGCAGGAAACTTAGCCCATGCAGGAG Asiatic Elephant

[17]

CCCCCATCCTTTCTACTTCTGCTAGCCTCTTCTATAGTAGAAGCCGGAGCAGGAACAGGCTGAACAGTATACCCGCCT  
CTGGCGGGTAATTTAGCCACGCAGGGG Cape Rock Hyrax

[18]

CCCCCATCTTTCACACTACTACTCTCCTCAGCCTGCATCGAAGCAGGTGCTGGAACAGGGTGAACCGTCTACCCTCCC  
CTAGCCGGAAACCTAGCCACGCCGGGC American Alligator

[19]

CCTCCCTCCTTCCTTCTCCTACTAGCCTCATCTACCGTAGAAGCTGGGGCCGGCACAGGATGGACAGTTTACCCCCCTT  
TAGCCGGCAACCTAGCCACGCTGGCG Chicken

Con

CC?CCATCCTTCTACTACTACTAGCCTC?TCTATAGTAGAAGC?GG?GCAGGAAC?GGATGAAC?GT?TACCCTCCCCT  
AGC?GG?AACCTAGCCCATGCAGGAG Consensus

[1]

CCTCTGTAGATCTAACAATTTTCTCGCTCCACTTGGCAGGTGTATCATCTATTCTTGGAGCTATCAACTTCATCACTACC  
ATCATTAATATAAAACCCCCTGCAAT Harbor\_Seal

[2]

CATCTGTAGATCTAACGATTTTCTCCCTCCATTGGCAGGTGTATCATCTATTCTTGGGGCTATCAACTTCATCACCACCA  
TTATTAATATAAAACCCCCTGCAAT Caspian Seal

[3]

CATCCGTAGATTAAACGATTTTCTCCCTTCATCTGGCAGGTGTATCATCTATTCTCGGGGCCATCAACTTCATCACTACTA  
TCATTAATATAAAACCCCCTGCAAT Harp Seal

[4]

CATCCGTAGACCTGACAATTTTCTCCCTTCACCTAGCAGGAGTATCATCCATCCTTGGAGCTATTAATTTTACTACTACTA  
TCATCAATATAAAACCTCCTGCAAT Leopard Seal

[5]

CATCTGTAGACTTAACAATTTTCTCTCTTCACCTGGCAGGTGTATCATCCATCCTTGGGGCTATTAATTTTATTACTACCA  
TTATCAACATAAAACCTCCTGCAAT Crabeater Seal

[6]

CATCTGTAGACCTAACAATTTTCTCTCTTCACCTGGCAGGTGTATCATCCATCCTTGGAGCCATCAACTTTATTACCACT  
ATTATTAACATAAAACCCCCTGCAAT Elephant Seal

[7]

CTTCCGTAGACTTAACTATTTTCTCCCTTCACCTGGCAGGAGTATCATCTATTCTGGGAGCCATTAACCTTTATTACTACTA  
TTATCAACATGAAACCCCCTGCCAT SA Fur Seal

[8]

CTTCCGTAGACTTGACTATTTTCTCCCTTCACCTGGCTGGAGTGTATCATCTATTCTAGGAGCCATTAACCTTTATTACCACT  
ATTATCAACATGAAACCCCCTGCTAT Aus Sea Lion

[9]

CTTCCGTAGACTTGACTATTTTCTCCCTTCACCTGGCAGGAGTATCATCTATTCTGGGAGCCATCAACTTTATTACTACC  
ATTATCAACATGAAACCCCCGCTAT Cali Sea Lion

... ..

[12]

CATCCGTAGACCTAACTATTTTTTCACTACACCTGGCAGGTGTCTCCTCAATCTTGGGTGCTATTAATTTTACTACTACTA  
TTATTAATATAAAACCTCCTGCCAT House Cat

[13]

CATCCGTTGACCTTACAATTTTCTCCTTACACTTAGCCGGAGTCTCTTCTATTTTAGGGGCAATTAATTTTCATCACTACTA  
TTATCAACATAAAACCCCCTGCAAT Dog

[14]

CCTCGGTAGATCTGACTATCTTCTCGCTCCATCTGGCTGGAGTATCTTCAATTCTAGGGGCTATTAACCTTTATCACTACA  
ATTATCAACATGAAACCTCCAGCCAT Caribbean Manatee

[15]

CCTCTGTAGATCTAACAATCTTCTCACTCCATCTAGCCGGGGTATCTTCGATTCTAGGGGCTATTAACCTTTATTACTACAA  
TTATCAATATAAAACCCCCAGCTAT Steller's Sea Cow

[16]

CTTCTGTAGATTAACTATTTTTCTCACTTACCTTGCAGGAGTATCCTCTATTCTAAGTGCAATTAATTTTATCACTACCAT  
CATCAACATAAAACCCCCAGCCAT Asiatic Elephant

[17]

CCTCTGTAGACCTTACAATCTTCTCACTACACCTAGCAGGGGTTTCCTCAATCTTAGGGGCTATCAACTTCATCACCCT  
ATCATTAACATAAAACCCCCAGCAAC Cape Rock Hyrax

[18]

CATCCGTAGATTAACTATCTTCTCTCACTTAGCCGGAGTATCTTCCATCCTCGGAGCAATTAACCTTTATTACAACAG  
CAATCAACATAAAACCCCCAGCAAT American Alligator

[19]

CATCAGTAGACCTAGCCATCTTTTCATTACACTTAGCAGGTGTTTCCTCCATTCTAGGAGCCATCAACTTTATCACTACC  
ATCATCAACATAAAACCCCCGCACT Chicken

Con

CATCCGTAGACCTAAC?ATTTTCTC?CTTCACCTGGCAGG?GTATCATC?ATTCT?GG?GC?ATTAACCTTTATTACTAC?AT  
TATCAACATAAAACCCCCTGCAAT Consensus

aln (531..636)

names

[1]

GTCTCAATACCAAACCTCCACTGTTCGTATGATCCGTATTAATCACAGCGGTGCTCCTACTATTGTCACTACCAGTCCTGG  
CAGCTGGCATCACCATGCTACTCACA Harbor\_Seal

[2]

GTCTCAATACCAAACCTCCACTGTTCGTGTGATCCGTATTAATCACGGCAGTGCTCCTGCTATTGTCACTACCAGTCCTAG  
CAGCTGGCATCACCATGTTACTTACA Caspian Seal

[3]

GTCTCAATACCAAACCTCCACTATTTGTATGATCCGTGTTAATCACGGCAGTACTCCTACTATTGTCACTACCAGTCCTAGC  
AGCTGGCATTACCATGCTACTTACA Harp Seal

[4]

ATCTCAATATCAAATCCCCTGTTCGTGTGATCTGTACTAATCACAGCAGTCCTCCTACTGCTATCACTACCAGTCCTAGC  
AGCTGGTATTACTATACTACTTACA Leopard Seal

[5]

ATCTCAATACCAAATCCCCTATTTCGTGTGATCCGTACTGATCACAGCAGTACTCCTACTGCTATCACTACCAGTCCTAGC  
AGCTGGCATTACTATACTACTTACA Crabeater Seal

[6]

ATCTCAATATCAAATTCCTTATTCGTATGATCCGTACTAATTACAGCAGTACTTCTGCTATTATCACTACCAGTTCTAGCA  
GCTGGTATTACTATACTACTTACA Elephant Seal

[7]

ATCCCAATACCAAACCCCTTTATTCGTGTGATCCGTACTAATCACAGCAGTACTACTTCTGCTATCCCTACCAGTCCTGG  
CAGCTGGTATCACTATATTACTTACG SA Fur Seal

[8]

GTCCCAATACCAAACCCCCCTATTTCGTGTGATCCGTACTAATCACAGCGGTACTACTTCTGCTGTCCCTACCAGTCCTAG  
CAGCTGGTATCACTATATTACTTACG Aus Sea Lion

[9]

GTCCCAAGTACCAAACCTCTTTATTCGTGTGATCCGTACTAATCACAGCAGTACTACTTCTGCTATCCCTACCAGTACTAG  
CAGCCGGTATCACTATACTACTTACG Cali Sea Lion

... ..

[12]

GTCCCAATATCAAACACCTCTATTTGTCTGATCAGTCTTAATCACTGCTGTCTTACTACTTCTATCACTTCCAGTCTTAGC  
AGCGGGAATCACTATATTATTAACA House Cat

[13]

ATCCCAGTATCAAACCTCCCCTGTTTGTATGATCAGTACTAATTACAGCAGTTCTACTCTTACTATCCCTGCCTGTACTGGC  
TGCTGGAATTACAATACTTTTAACA Dog

[14]

ATCTCAATACCAAACCTCCCCTGTTTGTCTGATCTGTTCTAGTCACAGCCGTCCTTCTTCTTCTGTCCCTCCCAGTTCTAG  
CAGCAGGAATCACTATACTCCTGACG Caribbean Manatee

[15]

AACCCAATACCAGACTCCCTTGTTTGTGTTGATCTGTCCTAGTAACAGCTGTTCTACTTCTTCTGTCCCTCCCAGTCCTAG  
CAGCAGGTATCACCATACTTCTAACT Steller's Sea Cow

[16]

GTCTCAATATCATATACCCTTATTTGTATGATCCATTTTAGTTACAGCCGTTCTTCTTCTTCTATCTCTCCCAGTTCTAGCA  
GCAGGTATTACAATACTATTAACG Asiatic Elephant

[17]

CACCCAATACCAAACACCCCTATTTCGTTTGTATCCGTACTAATCACTGCTGTACTCCTTTTATTATCCCTACCAGTGCTAGC  
AGCCGGAATTACAATACTACTAACA Cape Rock Hyrax

[18]

ATCCCAATACCAAACACCACTATTTGTGTGATCCGTCCTAATTACAGCTGTACTTCTCCTACTATCCCTACCAGTACTAGC  
TGCTGGAATTACAATACTACTCACA American Alligator

[19]

GTCACAATACCAAACACCCCTATTTCGTATGATCCGTCCTCATTACTGCCATCCTACTACTCCTCTCCTTACCCGTCCTAGC  
AGCTGGGATTACCATACTACTTACC Chicken

Con

ATCCCAATACCAAACCTCCCCTATTTCGT?TGATCCGTACTAATCACAGC?GTACT?CT?CT?CTATCCCTACCAGTCCTAGC  
AGCTGG?ATTACTATACTACTTACA Consensus

aln (637..742)

names

[1]

GACCGAAACCTGAATACAACATTCTTCGACCCTGCCGGAGGAGGTGATCCTATCCTGTATCAACATCTGTTCTGATTCT  
TCGGACATCCTGAGGTGTATATTCTAA Harbor\_Seal

[2]

GACCGAAACCTGAATACAACATTCTTCGACCCTGCCGGAGGAGGTGATCCTATCCTGTATCAACATCTATTCTGATTCT  
TCGGGCATCCCGAAGTGTATATTCTAA Caspian Seal

[3]

GATCGGAATCTAAACACAACATTCTTCGATCCTGCCGGAGGAGGTGATCCTATCCTATATCAACATCTGTTCTGATTCTT  
CGGACACCCCGAAGTGTATATCCTGA Harp Seal

[4]

GATCGAAACCTAAATACAACATTCTTTGACCCCGCTGGAGGAGGGGACCCTATTTTATATCAACATCTATTCTGATTCTT  
TGGACATCCCGAAGTTTATATTCTAA Leopard Seal

[5]

GATCGAAATCTAAATACAACATTCTTCGATCCTGCTGGAGGAGGTGACCCTATTCTGTATCAACATCTATTTTGATTCTT  
TGGACACCCTGAAGTTTACATTCTAA Crabeater Seal

[6]

GACCGAAATCTAAATACAACATTCTTTGATCCTGCTGGAGGAGGTGACCCTATTCTATATCAACATCTATTCTGATTCTT  
TGGACACCCCGAAGTATATATTCTAA Elephant Seal

[7]

GACCGAAATCTAAACACAACCTTTTTTGATCCAGCCGGAGGGGGTGACCCTATCCTATATCAACACCTATTCTGATTCTT  
TCGGACACCCAGAAGTATATATTCTCA SA Fur Seal

[8]

GACCGAAATCTAAATACAACCTTTTTTGATCCAGCCGGAGGGGGTGACCCTATCCTATATCAACACCTATTCTGATTCTT  
TCGGACATCCAGAAGTATATATTCTTA Aus Sea Lion

[9]

GACCGAAATCTAAATACAACCTTTTTTCGATCCAGCCGGAGGGGGTGACCCTATCCTATATCAACATCTATTCTGATTCTT  
CGGACACCCAGAAGTATATATTCTTA Cali Sea Lion

... ..

[12]

GATCGAAACCTAAACACCACATTCTTTGACCCCGCTGGGGGAGGAGATCCTATCTTATACCAACACTTATTCTGATTCTT  
TTGGCCATCCAGAAGTTTACATTTTAA House Cat

[13]

GACCGGAATCTTAATACAACATTTTTGATCCCGCTGGAGGAGGAGACCTATCCTATATCAACACCTATTCTGATTCTT  
CGGACATCCTGAAGTTTACATTCTTA Dog

[14]

GACCGCAACCTAAACACTACCTTCTTTGACCCGGCTGGAGGGGAGACCCAATCCTGTACCAACACCTATTCTGATTCT  
TTCGGGCACCCTGAAGTGACATTCTTA Caribbean Manatee

[15]

GATCGTAACCTAAACACAACCTTCTTCGATCCAGCTGGAGGAGGGGATCCAATCCTGTATCAACATCTATTCTGATTCT  
TTGGACACCCTGAAGTGATATTCTTA Steller's Sea Cow

[16]

GATCGCAATCTCAATACTACTTTCTTTGACCCTGCAGGAGGAGGAGACCCAGTTCTATACCAACACCTATTCTGGTTTT  
TTGGACACCCTGAAGTCTATATTCTAA Asiatic Elephant

[17]

GATCGAAACATCAACACAACCTTTTTGACCCAGCGGGTGGAGGAGACCCAGTTCTATACCAACATCTATTCTGATTCT  
TTCGGACACCCTGAAGTTTACATCCTCA Cape Rock Hyrax

[18]

GACCGCAACTTAAACACAACCTTCTTTGACCCGCAGGGGGAGGAGATCCCATCCTATACCAACACCTCTTCTGATTCT  
TTTGGCCACCCAGAAGTATATATCCTAA American Alligator

[19]

GACCGCAACCTTAACACCACATTCTTCGACCCAGCTGGAGGAGGAGACCCAATCCTATACCAACACCTATTCTGATTCT  
TTCGGTCACCCCGAAGTTTACATCCTCA Chicken

Con

GACCGAAATCTAAATACAAC?TTCTTTGATCC?GC?GGAGGAGG?GACCCTATCCTATATCAACATCTATTCTGATTCTT  
CGGACACCC?GAAGT?TATATTCT?A Consensus

aln (743..848)

names

[1]

TCCTACCAGGATTCGGAATAATCTCACACATCGTTACCTACTATTTCAGGAAAAAAGAACCTTTTGGTTATATAGGAAT  
AGTTTGAGCAATAATGTCCATCGGCTT Harbor\_Seal

[2]

TCCTACCAGGATTCGGAATAATCTCACACATTGTCACCTACTATTTCAGGGAAAAAAGAACCTTTTGGTTATATAGGAAT  
AGTTTGAGCAATAATGTCCATCGGCTT Caspian Seal

[3]

TCCTACCAGGATTCGGAATAATCTCACACATCGTCACCTACTATTTCAGGGAAAAAAGAACCTTTTGGTTACATAGGAAT  
AGTTTGAGCAATAATGTCCATCGGCTT Harp Seal

[4]

TTCTTCAGGATTCGGAATAATTTTCGCACATCGTTACCTACTACTCAGGAAAAAAGAACCCTTTTGGCTATATAGGAAT  
AGTATGAGCAATAATATCCATTGGCTT Leopard Seal

[5]

TCCTTCAGGATTCGGAATGATTTCACATATCGTTACCTATTATTCAGGGAAAAAAGAACCCTTTTGGTTATATAGGAATA  
GTCTGAGCAATAATATCTATCGGCTT Crabeater Seal

[6]

TTCTTCAGGATTTGGAATAATCTCACACATCGTCACCTACTACTCAGGAAAAAAGAACCCTTCGGCTATATAGGAAT  
AGTCTGAGCAATAATATCCATTGGTTT Elephant Seal

[7]

TCCTACCAGGATTCGGGATAATCTCACACATCGTCACCTACTACTCAGGAAAAAAGGAACCCTTTGGTTATATAGGAAT  
AGTCTGAGCAATAATATCCATCGGCTT SA Fur Seal

[8]

TTTTGCCAGGATTCGGTATAATCTCACATATCGTCACCTATTACTCAGGAAAAAAGAACCCTTCGGCTATATAGGAATA  
GTCTGAGCAATAATATCCATCGGCTT Aus Sea Lion

[9]

TCCTACCAGGGTTTCGGAATAATCTCTCATATCGTCACATATTATTCAGGAAAAAAGGAACCCTTTGGCTATATAGGAAT  
GGTCTGAGCAATAATATCCATTGGCTT Cali Sea Lion

... ..

[12]

TCCTACCCGGTTTTGGGATAATCTCACATATTGTTACCTATTATTCAGGTAAAAAAGAACCCTTTGGCTACATGGGAATA  
GTTTGAGCCATGATATCAATCGGCTT House Cat

[13]

TCCTGCCCCGATTCGGAATAATTTCTCACATTGTCACTTACTACTCAGGGAAAAAAGAGCCTTTTCGGTTATATAGGAAT  
AGTATGAGCAATAATATCTATTGGGTT Dog

[14]

TCCTACCCGGCTTCGGTATAATTTTCACACATCGTCACTTATTATTCAGGTAAAAAAGAACCATTTCGGTTATATAGGTATG  
GTTTGGGCCATAATGTCTATCGGCTT Caribbean Manatee

[15]

TCCTGCCGGGATTCGGTATAATCTCACATATCGTCACCTATTATTCAGGCAAAAAAAGAACCCTTTGGATATATAGGAATA  
GTTTGAGCCATAATGTCAATTGGTTT Steller's Sea Cow

[16]

TTCTCCCAGGATTTGGAATAGTTTCTCATATCGTTACGTACTACTCAGGGAAAAAAGAACCCTTTGGCTATATAGGGAT  
AGTGTGGGCTATAATATCAATTGGTTT Asiatic Elephant

[17]

TTTTACCCGGATTTGGAATAATCTCCCACATTGTCACTACTACTCAGGCAAAAAAAGAACCCTTTTCGGTTACATAGGTAT  
GGTATGAGCCATAATATCAATTGGCTT Cape Rock Hyrax



[18]

TTCTTCCAGGGTTTCGGAATAATTTCCCACGTAGTAGCCTTTTATTCAGGCAAAAAAGAACCATTTCGGCTATATAGGAAT  
AGCATGAGCCATATTATCCATTGGATT American Alligator

[19]

TCCTCCCAGGTTTCGGAATAATTTCCCACGTAGTAGCATACTATGCAGGAAAAAAGAACCATTTCGGATACATAGGAA  
TAGTCTGAGCCATACTGTCAATCGGATT Chicken

Con

TCCTACCAGGATTCGGAATAATCTCACACATCGTCACCTACTATTCAGG?AAAAAAGAACC?TTTGG?TATATAGGAATA  
GT?TGAGCAATAATATCCATTGGCTT Consensus

aln (849..954)

names

[1]

CCTGGGCTTCATTGTATGAGCCCACCATATATTTACTGTAGGGATGGACGTCGACACACGAGCATACTTCACTTCAGCC  
ACTATAATTATTGCAATTCCAACGGGA Harbor\_Seal

[2]

CCTGGGCTTCATTGTATGAGCCCACCATATATTTCACTGTAGGGATGGACGTCGACACACGAGCATACTTCACTTCAGCC  
ACTATAATTATTGCAATTCCGACAGGA Caspian Seal

[3]

TCTAGGCTTCATTGTATGAGCCCACCATATATTTCACTGTAGGGATGGACGTTGATACACGAGCATACTTTACTTCAGCC  
ACTATAATCATTGCAATTCCAACAGGA Harp Seal

[4]

CCTAGGCTTCATCGTATGAGCCCACCATATATTTACCGTAGGAATGGATGTTGATACACGAGCATACTTTACTTCAGCCA  
CTATAATTATTGCAATTCCAACAGGA Leopard Seal

[5]

CTTAGGCTTCATCGTATGAGCCCACCATATATTTCACTGTAGGAATAGATGTTGATACACGAGCATACTTCACCTCAGCCA  
CTATAATTATTGCAATTCCAACAGGA Crabeater Seal

[6]

CCTAGGCTTCATTGTATGAGCTCATCATATATTTACCGTAGGAATAGATGTTGACACACGAGCTTATTTCACTTCAGCCA  
CTATAATTATTGCAATTCCAACAGGA Elephant Seal

[7]

CTTAGGCTTTATCGTATGAGCACATCATATATTTACCGTAGGAATAGATGTTGACACACGAGCATACTTCACCTCAGCC  
ACTATAATTATCGCCATCCCTACAGGA SA Fur Seal

[8]

CCTAGGCTTTATCGTATGAGCACATCACATATTTACCGTAGGAATGGATGTTGACACGCGAGCATACTTCACCTCAGCC  
ACTATAATTATCGCTATCCCTACAGGA Aus Sea Lion

[9]

CTTAGGCTTTATCGTATGAGCACATCATATATTCACCGTAGGAATAGATGTTGACACGCGAGCATATTTACCTCAGCCA  
CTATAATCATCGCCATCCCTACAGGA Cali Sea Lion

... ..

[12]

CCTGGGCTTTATCGTATGAGCCCATCATGTTTACTGTAGGAATGGATGTAGACACACGAGCATACTTTACATCAGCC  
ACTATAATTATTGCCATTCCTACCGGG House Cat

[13]

TTTAGGCTTTATCGTATGAGCTCACCATATGTTTACCGTAGGAATAGATGTAGACACACGAGCGTACTTTACGTCCGCC  
ACTATAATTATCGCTATTCCAACGGGA Dog

[14]

TCTCGGTTTCATCGTATGAGCTCATCATATATTCACCGTAGGTATAGATGTGGACACTCGAGCCTACTTTACGTCAGCCA  
CAATAATTATTGCCATCCCCACAGGT Caribbean Manatee

[15]

CCTAGGATTTATTGTGTGAGCTCACCATATATTCACTGTAGGAATAGACGTGGACACTCGAGCCTACTTTACATCAGCT  
ACGATAATCATTGCTATCCCAACGGGT Steller's Sea Cow

[16]

CCTAGGGTTCATTGTATGAGCCCACCATATATTCACCGTAGGTATAGACGTTGACACTCGAGCTTACTTTACATCAGCTA  
CTATAATTATTGCTATTCCAACGGG Asiatic Elephant

[17]

CTTAGGATTTATTGTATGAGCTCACCATATATTCACAGTGGGAATAGACGTAGACACCCGAGCTTATTTACGTCAGCC  
ACCATAATTATCGCAATCCCAACAGGA Cape Rock Hyrax

[18]

CTTAGGGTTCATCGTCTGAGCCCACCACATATTTACAGTCGGAATAGACGTAGACACCCGAGCATACTTTACCACCGC  
CACAATAATCATTGCCGTTCCACCGGG American Alligator

[19]

CCTTGGCTTCATTGTATGAGCCCACCATATATTCACAGTCGGAATGGACGTAGACACCCGAGCCTACTTTACATCAGCC  
ACAATAATCATCGCCATCCCAACTGGT Chicken

Con

CCTAGGCTTCATCGTATGAGC?CACCATATATTCAC?GTAGGAATAGATGTTGACACACGAGCATACTTTAC?TCAGCCA  
CTATAATTATTGC?ATTCCAACAGGA Consensus

aln (955..1060)

names

[1]

GTTAAGGTATTAGCTGACTAGCTACCTTCATGGGGGCAATATCAAATGGTCTCCAGCCATATTATGAGCCCTGGGCT  
TTATCTTCTATTTACGGTAGGGGGCC Harbor\_Seal

[2]

GTAAAGTATTCAGCTGACTAGCTACCCTTCATGGGGGCAATATCAAAGTGATCTCCAGCCATATTATGAGCCCTGGGCT  
TTATCTTCTATTTACAGTGGGGGGCC Caspian Seal

[3]

GTAAAGTATTTAGCTGACTAGCCACCCTTCATGGGGGCAATATCAAATGATCTCCAGCCATACTATGAGCCCTGGGCT  
TTATCTTCTATTTACAGTAGGGGGAC Harp Seal

[4]

GTAAAGTATTTAGCTGATTAGCTACCCTACATGGAGGTAACATCAAATGATCTCCAGCTCTACTATGAGCTCTAGGATT  
TATTTTCTATTCACAGTAGGGGGTC Leopard Seal

[5]

GTAAAGTCTTTAGCTGATTAGCTACTCTACACGGAGGCAACATCAAAGTGATCTCCAGCTATACTATGAGCTCTAGGGT  
TTATCTTCTATTCACAGTAGGAGGTC Crabeater Seal

[6]

GTAAAGTCTTCAGCTGACTGGCTACTCTGCACGGAGGCAATATCAAATGATCTCCAGCCATACTATGAGCTCTAGGA  
TTTATTTTCTATTCACAGTTGGAGGTC Elephant Seal

[7]

GTAAAGTATTTAGCTGACTAGCTACTCTGCATGGTGGTAATATCAAATGATCTCCTGCCATACTATGAGCCTTAGGATT  
TATCTTCTATTCACAGTAGGAGGCC SA Fur Seal

[8]

GTAAAGTATTTAGCTGGCTAGCTACTCTGCATGGTGGCAATATCAAAGTGGTCTCCCGCTATACTATGAGCCCTAGGAT  
TCATTTTCTATTCACAGTAGGGGGCC Aus Sea Lion

[9]

GTAAAGTATTTAGCTGACTAGCTACCCTGCACGGCGGCAATATCAAATGATCTCCTGCCATACTATGAGCTTTAGGAT  
TCATCTTCTATTCACAGTAGGAGGTC Cali Sea Lion

... ..

[12]

GTGAAAGTATTTAGTTGACTGGCTACTCTTCATGGAGGTAATATTAAATGGTCCCCTGCTATATTATGAGCCTTAGGCTT  
TATTTTCTATTTACCGTAGGAGGCC House Cat

[13]

GTAAAGTATTTAGTTGACTGGCAACACTTCATGGAGGCAATATTAAATGATCTCCAGCTATGCTATGAGCTTTAGGGT  
TTATTTTCTTATTTACAGTAGGCGGGT Dog

[14]

GTAAAGTATTCAGCTGATTAGCCACGCTACACGGTGGCAATATCAAATGATCTCCTGCCCTACTATGAGCCCTGGGCT  
TTATCTTCTGTTCACAGTCGGAGGCC Caribbean Manatee

[15]

GTGAAAGTATTCAGCTGATTAGCTACGCTCCACGGCGGCAATATCAAATGGTCCCCTGCCCTACTGTGAGCCCTAGGC  
TTTATCTTCTATTCACAGTTGGAGGCT Steller's Sea Cow

[16]

GTAAAAGTCTTTAGCTGACTAGCTACCCTTCATGGCGGTAATATTAAATGATCCCCGCTATAATATGAGCCCTAGGATT  
TATCTTCTTATTACAATTGGGGGGT Asiatic Elephant

[17]

GTAAAAGTATTCAGCTGACTAGCAACCCTTCACGGAGGTAATATTAAGTATCCCCGCCATACTATGAGCCCTAGGAT  
TCATCTTCTTATTCACAGTAGGTGGCC Cape Rock Hyrax

[18]

GTAAAAGTATTTAGCTGACTAGCCACCATCTATGGCGGCATTGTAACTGACAAGCCCCAATACTCTGAGCACTAGGC  
TTCATCTTCTTATTACCGTCGGGGGCC American Alligator

[19]

ATTAAAGTCTTCAGCTGACTAGCAACCCTGCACGGAGGAACAATTAAATGAGACCCCCCTATGCTATGAGCCCTAGGA  
TTCATCTTCTTCTTCACTATCGGAGGCC Chicken

Con

GTAAAAGTATTTAGCTGACTAGCTAC?CT?CATGG?GGCAATATCAAATGATCTCC?GCCATACTATGAGCCCTAGGATT  
TATCTTCTTATTCACAGTAGGAGGCC Consensus

aln (1061..1166)

names

[1]

TCACAGGTATCGTACTAGCCAACTCATCACTAGACATTGTCCTTCATGACACATACTATGTGGTAGCACATTTCCATTAT  
GTTTTATCAATAGGAGCAGTATTCGC Harbor\_Seal

[2]

TCACAGGTATCGTACTAGCCAACTCATCACTAGACATTGTCCTTCATGACACATACTATGTAGTAGCACATTTCCATTATG  
TTTTATCAATAGGAGCAGTATTCGC Caspian Seal

[3]

TCACAGGTATTGTACTAGCTAACTCATCACTAGACATTGTCCTTCATGACACATACTATGTAGTAGCACACTTCCACTAT  
GTCCTATCAATAGGAGCAGTATTCGC Harp Seal

[4]

TTACGGGCATTGTACTAGCAAACCTCGTCACTAGATATCGTACTCCACGATACATACTATGTAGTAGCACACTTCCACTAC  
GTCTTATCAATAGGAGCAGTATTCGC Leopard Seal

[5]

TTACGGGCATCGTATTAGCAAACCTCATCACTAGATATCGTACTCCATGATACATACTATGTAGTAGCGCACTTCCACTAC  
GTCTTATCAATAGGAGCAGTCTTCGC Crabeater Seal

[6]

TTACGGGCATCGTACTAGCAAATTCGTCACTGGACATCGTGCTCCATGATACATACTATGTAGTAGCGCACTTCCACTAC  
GTACTATCAATAGGAGCAGTCTTCGC Elephant Seal

[7]

TCACAGGCATTGTGTTAGCAAATTCATCATTAGATATCGTCCTCCACGACACATACTACGTGGTGGCACACTTTCATTAC  
GTATTATCAATAGGAGCGGTGTTTGC SA Fur Seal

[8]

TCACAGGCATTGTGTTAGCAAATTCATCATTAGATATCGTCCTCCACGATACATATTACGTAGTAGCACACTTCCATTAC  
GTGTTATCAATAGGAGCAGTGTTTGC Aus Sea Lion

[9]

TCACAGGCATTGTGCTAGCAAACATCATCATTAGATATTGTCCTCCACGACACATACTACGTAGTGGCCCACTTCCATTAC  
GTATTATCAATAGGAGCAGTGTTTGC Cali Sea Lion

... ..

[12]

TAACGGGAATTGTACTAGCAAACCTCTCATTAGACATTGTTCTTCACGACACATATTACGTAGTGGCCCACTTTCCTAT  
GTCTTGTCAATAGGAGCAGTATTCGC House Cat

[13]

TAACAGGTATTGTCCTAGCTAATTCGTCCTTAGACATCGTTCTTCATGATACATATTATGTTGTGGCTCATTTTCACTATGT  
GCTTTCAATAGGAGCAGTTTTTGC Dog

[14]

TAACAGGAATTGTCCTAGCCAACTCATCATTAGATGTCATCCTCCATGACACCTACTATGTCGTAGCACACTTTCCTAT  
GTCCTCTCTATAGGTGCAGTATTCGC Caribbean Manatee

[15]

TAACGGGAATTGTTCTAGCTAACTCATCATTAGACGTTGTCCTCCATGACACCTACTATGTCGTAGCACACTTCCACTAC  
GTCCTATCTATAGGCGCTGTATTCGC Steller's Sea Cow

[16]

TAACGGCATTGTCCTTGCTAATTCCTACTAGACATTGTCCTACATGACACTTACTACGTTGTAGCTCACTTTCCTACTAC  
GTCTTATCTATAGGTGCAGTTTTTGC Asiatic Elephant

[17]

TCACAGGGATCGTACTCGCCAACTCTCCTTAGACATTGTCCTTCATGACACTTACTACGTTGTAGCCCACTTCCACTAC  
GTCCTGTCAATAGGAGCTGTCTTCGC Cape Rock Hyrax

[18]

TAACGGGATTGTCCTAGCCAACTCCTCACTAGACATTGTCCTCCACGACACTTATTATGTAGTGGCCCACTTCCACTAC  
GTACTCTCAATAGGAGCAGTCTTCGC American Alligator

[19]

TAACGGGAATCGTCCTTGCTAACTCATCACTAGATATTGCCCTTCATGACACCTACTATGTAGTCGCCCACTTCCACTAT  
GTCCTCTCAATGGGGGCAGTTTTTGC Chicken

Con

T?ACAGG?ATTGT?CTAGC?AACTCATCACTAGACATTGTCCTCCATGACACATACTATGTAGTAGCACACTTCCACTAC  
GT?CTATCAATAGGAGCAGT?TTCGC Consensus

aln (1167..1272)

names

[1]

TATTATGGGTGGATTGTCATTGATTCCCCCTATTCTCAGGCTATATACTCGACGACACTTGAGCAAAAATTCACTTCA  
CAATCATATTCGTAGGAGTCAACATA Harbor\_Seal

[2]

TATTATGGGCGGATTTGTCCATTGATTCCCCCTATTCTCGGGCTATACACTCGACGACACTTGAGCAAAAATTCACTTC  
ACAATCATGTTTCGTAGGAGTCAACATA Caspian Seal

[3]

TATCATGGGCGGATTGTCATTGATTCCCCCTATTCTCAGGCTACACGCTTAATAATACCTGAGCAAAGATTCACTTCA  
CAATCATATTCGTGGGAGTCAACATA Harp Seal

[4]

TATCATAGGCGGATTTGTTCACTGATTCCCCCTATTCTCAGGCTTCACTCTTGACGACACTTGAGCAAAAATTCACTTTA  
CAATTATATTTGTTGGGGTTAACATA Leopard Seal

[5]

TATTATAGGCGGATTGTTCACTGATTCCCCCTATTCTCAGGCTTCACTCTCGATGATACCTGAGCAAAAATTCACTTCA  
CAATTATATTTGTTGGAGTTAACATA Crabeater Seal

[6]

CATTATGGGCGGATTTGTACACTGATTCCCCCTATTCTCAGGCTTCACTCTCGATGACACCTGAGCAAAAATTCACTTT  
ACAATTATATTTGTTGGAGTTAACATA Elephant Seal

[7]

TATCATGGGCGGATTGTTCACTGATTCCCCCTATTTTCAGGATTTATGCTCGATAGTACCTGGGCGAAAATCCACTTCA  
CAATCATATTTGTTGGGGTCAATATG SA Fur Seal

[8]

TATCATGGGCGGATTGTCATTGATTCCCTTTATTTTCAGGATTCATGCTCGATAATACCTGAGCGAAAATCCACTTCA  
CAATCATATTCGTTGGAGTCAATATA Aus Sea Lion

[9]

TATCATGGGCGGATTTGTCCATTGATTCCCCCTATTCTCAGGATTCATGCTCGACAGCACCTGAGCGAAAATCCACTTC  
ACAATCATATTTGTTGGAGTCAACATG Cali Sea Lion

... ..

[12]

TATCATAGGAGGCTTCGTCCATTGATTCCCCCTATTCTCAGGATATACCCTTGACAACACTTGAGCAAAGATTCACTTTA  
CGATTATGTTTGTAGGAGTCAATATA House Cat

[13]

CATTATGGGAGGATTTGCCCACTGATTCCCTTTATTCTCAGGTTATACTCTTAACGATACTTGAGCAAAGATTCACTTTA  
CAATTATGTTTGTGGGAGTAAATATA Dog

[14]

CATTATGGGTGGATTTCGTGCACTGATTCCCTCTATTTTCAGGATACACACTTAATCAAACATGAGCCAAAATCCACTTCC  
TAATCATATTTGTTGGTGTTAACCTA Caribbean Manatee

[15]

CATCATGGGTGGGTTTCGTCCACTGATTCCCTCTATTTTCAGGATACACACTCAACCAGACATGAGCTAAAATCCACTTC  
TTAATCATATTTGTAGGTGTCAACTTA Steller's Sea Cow

[16]

CATTATAGGTGGGTTTATTCAGTATTTCCACTATTTTCAGGATACACATTAAATTATACATGAGCTAAAATTCAATTTCT  
AGTTATATTTATCGGTGTTAATTTG Asiatic Elephant

[17]

AATCATGGGAGGATTTCGTCCACTGATTTCCTCTCTGGATATACACTAAATCTCACATGGGCCAAAATCCACTTCA  
TCATCATATTCGTAGGAGTAAATCTA Cape Rock Hyrax

[18]

TATCATGAGCGGATTCACCCACTGATTCCCACTCTTTACAGGATTTACCCTTCACCCAACATGAACTAAAATCCAATTTG  
TAATTATATTTACCGGAGTAAATTT American Alligator

[19]

CATTCTAGCAGGATTTACCCACTGATTTCCTCTCTCACAGGCTTTACCCTACACCCATCATGAACCAAGGCACATTTCT  
GGAGTAATATTTACCGGAGTTAACCTA Chicken

Con

TATCATGGG?GGATTTCGTCCACTGATTCCCCCTATTCTCAGGATTCAC?CT?GAC?A?AC?TGAGCAAAAAT?CACTTCA  
CAATCATATTTGT?GGAGT?AACATA Consensus

aln (1273..1378)

names

[1]

ACATTCTTTCCCCAACACTTCCTAGGTCTATCAGGAATACCTCGGCGATACTCCGACTACCCAGACGCCTACACGACAT  
GAAATACAGTCTCCTCCATGGGCTCAT Harbor\_Seal

[2]

ACATTCTTTCCCCAACACTTCCTAGGTCTATCAGGAATACCTCGACGATACTCCGACTATCCAGACGCCTACACGACAT  
GAAATACAGTCTCCTCTATGGGCTCAT Caspian Seal

[3]

ACATTCTTTCCCCAACACTTCCTAGGTCTATCAGGAATACCTCGACGATATTCGACTACCCAGACGCCTACACGACAT  
GAAATACAGTCTCCTCCATGGGCTCAT Harp Seal

[4]

ACATTCTTTCCCCAACATTTCTTAGGCTTATCAGGAATACCTCGACGATATTCGACTACCCAGACGCCTACACAACAT  
GAAACACAGTCTCCTCTATAGGTTCTT Leopard Seal

[5]

ACATTCTTCCCTCAACATTTCTTAGGCTTATCAGGAATACCTCGACGATACTCCGACTACCCAGACGCCTACACAACAT  
GAAACACAGTCTCCTCTATAGGCTCAT Crabeater Seal

[6]

ACATTTTCCCTCAACATTTCTTAGGTCTATCAGGAATACCTCGACGATATTCCGACTATCCAGACGCCTATACAACATG  
AAACACAGTCTCTTCTATAGGTTTCAT Elephant Seal

[7]

ACATTCTTCCCAACATTTTTTAGGCCTATCCGGAATACCACGACGATACTCTGACTACCCAGACGCCTACACAACAT  
GAAATACAATCTCCTCTATAGGCTCGT SA Fur Seal

[8]

ACATTCTTCCCAACATTTTTCTAGGCCTATCCGGAATACCACGGCGATATTCTGATTACCCAGACGCTTACACAACAT  
GAAATACAATCTCCTCTATAGGCTCGT Aus Sea Lion

[9]

ACATTCTTCCCAACATTTTTCTAGGGCTGTCCGGAATACCACGACGATATTCTGACTACCCAGACGCCTATACAACAT  
GAAATACAATCTCTTCTATAGGTTTCGT Cali Sea Lion

... ..

[12]

ACGTTCTTCCCTCAGCACTTCCTAGGCCTGTCCGGAATGCCACGACGTTATTCTGACTATCCAGATGCATATACAACCT  
GAAATACGATTCCTCAATGGGCTCTT House Cat

[13]

ACTTTCTTCCCTCAACATTTCTAGGTTTATCTGGAATACCTCGTCGATACTCTGACTACCCAGATGCATATACTACCTGA  
AATACCGTCTCCTCTATAGGATCGT Dog

[14]

ACATTCTTCCCAACATTTCTTGGTCTATCCGGCATACTCGTCGATACTCAGACTACCCAGATGCCTACACCATGTG  
AAACACTGTGTCCTCTATGGGGTCGT Caribbean Manatee

[15]

ACATTCTTCCCTCAACATTTCTCGGCCTATCAGGCATGCCTCGCCGATACTCAGACTACCCAGACGCCTACACTCTATG  
AAATACTGTATCCTCTATGGGGTCAC Steller's Sea Cow

[16]

ACATTTTCCCAACACTTTCTTGGACTATCTGGCATACCACGTCGATATTCTGACTATCCAGATGCCTACACTGCATG  
AAACACTGCTTCTTCTATAGGTTTCAT Asiatic Elephant

[17]

ACATTCTTCCACAGCACTTCCTAGGACTATCCGGCATACTCGTCGATATTCCGACTACCCAGATGCATACACAGCAT  
GAAACATAGTCTCCTCAATAGGATCCT Cape Rock Hyrax

[18]

ACCTTCTTCCCAACACTTCCTAGGACTATCTGGGATACCTCGACGATACTCGGACTACCCAGACGCATACACCCTCT  
GAAACCTAACATCATCAATTGGATCCT American Alligator



[19]

ACCTTTTCCCCAACATTTCTGGGCCTAGCTGGAATACCCCGACGATACTCAGATTACCCAGACGCCTACACACTAT  
GAAACACACTATCCTCAATCGGCTCCT Chicken

Con

ACATTCTTCCC?CAACATTTCTAGG?CTATC?GGAATACCTCGACGATATTC?GACTACCCAGACGCCTACACAACATG  
AAATACAGTCTCCTCTATAGG?TC?T Consensus

aln (1379..1484)

names

[1]

TCATTTCACTTACAGCAGTGATATTAATAGTATTCATAATCTGAGAAGCTTTCGCATCCAAGCGAGAAGTAGCGGCAGT  
TGAATTAACTACAACATAATATCGAATG Harbor\_Seal

[2]

TCATTTCACTCACAGCGGTGATATTAATAGTATTCATAATCTGAGAAGCTTTCGCATCTAAGCGAGAAGTAGCAGCAGT  
TGAATTAACTACAACATAATATCGAATG Caspian Seal

[3]

TCATTTCACTCACAGCAGTAATATTAATAGTATTCATAATCTGAGAAGCTTTCGCATCTAAGCGAGAAGTAGCAGCAGT  
TGAATTAACTACAACATAATATCGAATG Harp Seal

[4]

TTATTTCACTCACAGCAGTAATGCTAATAGTATTCATGATCTGAGAAGCCTTTCGCATCCAAACGAGAAGTAGCAACAGT  
TGAATTAACTACAACATATCGAGTG Leopard Seal

[5]

TTATTTCACTTACAGCAGTAATACTAATAGTATTTATGATCTGAGAAGCCTTCGCATCCAAACGAGAAGTGGCAGTAGT  
TGAATTAACTACGACTAATATCGAATG Crabeater Seal

[6]

TTATCTCACTTACAGCAGTAATATTAATAGTCTTCATGATTTGAGAAGCCTTCGCATCAAAACGAGAAGTAGCAACAGT  
TGAATTAACCACAACAAACATAGAGTG Elephant Seal

[7]

TCATCTCACTTACGGCAGTGATACTTATGGTCTTCATAATCTGAGAAGCTTTGCGTCCAAACGAGAGGTAGAGACGA  
TTGAATAACATCGACTAATATGGAGTG SA Fur Seal

[8]

TCATCTCACTTACGGCAGTAATACTAATGGTCTTCATAATCTGAGAGGCTTTTGCATCTAAACGAGAAGTAGAGACGAT  
TGAGTTGACATCGACTAATATGGAATG Aus Sea Lion

[9]

TCATCTCGCTTACGGCAGTAATACTAATGGTCTTCATAATCTGAGAGGCTTTTGCATCTAAACGAGAGGTAGAGACGG  
TCGAATTAACATCAACTAATATGGAATG Cali Sea Lion

... ..

[12]

TCATCTCATTAAACAGCAGTCATGTTAATAGTTTTTCATAGTGTGAGAAGCTTTCGCATCCAAGCGAGAAGTGGCCATAGT  
AGAACTAACCAACTAATCTTGAATG House Cat

[13]

TTATCTCGCTTACAGCGGTGATGCTTATAATTTTTATGATCTGGGAAGCCTTTGCATCCAAACGAGAAGTTGCTATAGT  
AGAACTTACTACAATAACATTGAGTG Dog

[14]

TTATCTCTCTCACGGCCGTTATCCTAATAGTATTCATAGTGTGAGAAGCGTTCGCCTCTAAACGAGAAGTTTCCACAGT  
TGAGCTAACAACAATAACCTTGAATG Caribbean Manatee

[15]

TTATCTCACTTACAGCCGTAGTCCTGATAGTGTTTCATGGTATGAGAAGCATTTCGCCTCTAAACGAGAGGTCTCTGCAGT  
TGAGCTAACAACAATAATCTAGAATG Steller's Sea Cow

[16]

TTATCTCTTTAGTAGCCGTAATTCTAATAGTCTTTATAATTTGAGAGGCATTGCTTCTAAGCGCGAAGTTTCTATGATAG  
AACTCATAACAACAACGTAGAATG Asiatic Elephant

[17]

TCATTTCCCTAACAGCCGTAATCCTCATAGTATTCATTGTGTGAGAAGCATTTCGCTTCTAAACGAGAGGTATCCAAAGT  
AGAACTAACAACAACAACCTGGAGTG Cape Rock Hyrax

[18]

TAATTTCCATGGTTGCAGTTATCCTTCTAATATTTATTATCTGAGAAGCATTACATCAAAACGAAAAGTGACAGCACTC  
GAAATAACAATAACCAACATTGAGTG American Alligator

[19]

TAATTTCAATAACAGCCGTAATCATACTCATATTCATCGTCTGAGAAGCCTTCTCAGCAAAACGAAAAGTGCTCCAACC  
CGAATTAAGTCCCACTAATATCGAATG Chicken

Con

TCATTTCACT?ACAGCAGTAATACTAATAGT?TTCATAATCTGAGAAGC?TTCGCATC?AAACGAGAAGTAGC?ACAGT  
TGAATTAAC?ACAATAATAT?GAATG Consensus

aln (1485..1558)

names

[1] ACTGCATGGATGTCCCCCTCCTTACCACACATTTGAAGAGCCCACCTACGTCGTACTAAAATAA-----  
Harbor\_Seal

[2] ACTGCATGGATGTCCCCCTCCTTATCACACATTTGAAGAGCCCCTTACGTCGTACTAAAATAA----- Caspian  
Seal

[3] ACTGCATGGATGTCCTCCTCCCTACCACACATTTGAAGAACCCACTTACGTTGTACTAAAATAA----- Harp  
Seal

[4] ACTACACGGATGTCCTCCTCCTTATCATACATTTGAAGAACCTACTTATGTTGTATTAAAATAA----- Leopard  
Seal

[5] ACTACACGGATGTCCTCCTCTATCATACTTGAAGAACCTACTTATGTTGTATTAAAATAA----- Crabeater Seal

[6] ACTACACGGATGCCCTCCTCCCTACCATACATTCGAAGAACCTACTTACGTTGTATTAAAATAA----- Elephant Seal

[7] ACTTCACGGATGTCCTCCTCCCTATCACACATTCGAAGAACCTACCTATATTGTATCGAAATAA----- SA Fur Seal

[8] ACTTCACGGATGTCCTCCTCCCTATCACACATTCGAAGAACCTACCTTCATCATATTGAAATAA----- Aus Sea Lion

[9] ACTTCATGGATGCCCTCCTCCCTACCACACATTCGAAGAACCTACTTACATTATATTAAAATAA----- Cali Sea Lion

... ..

[12] ATTGCATGGATGTCCTCCTCCGTACCACACATTTGAAGAGCCAACTTACGTACTATTAAAATAA----- House Cat

[13] ACTACATGGATGTCCCCCTCCATACCACACGTTTGAAGAACCTACATATGTGATCCAAAAATAA----- Dog

[14] ACTCAACGGCTGCCACCATCATATCACACATTCGAGGAACCAGCCTACGTCAAGGTCTAG----- Caribbean Manatee

[15] ACTCAACGGTTGTCCACCTCCATACCACACATTTGAAGAGCCAACTACGTCAAAGTATAG----- Steller's Sea Cow

[16] ACTCAACGGGTGTCCACCTCCACATCATACATTCGAAGAACCAGCCTACGT-AAAATCTAACTCGAGAAGG--- Asiatic Elephant

[17] ATTAAATGGCTGCCCTCCCCCTTACCACACATTTGAAGAACCAGCATTTCGTTAAGCCCTA----- Cape Rock Hyrax

[18] ACTTAACAACCTGCCCCCATCTCATCACACCTACGAAGAGCCCGTATTCGCTGTAGTACGACCCAAATACTATG American Alligator

[19] AATTCATGGCTGCCACCCCCATACCACACCTTCGAAGAACCAGCCTTTGTACAAGTGCAAGAAAGG----- Chicken

Con ACT?CACGGATGTCCTCCTCC?TATCACACATTCGAAGAACC?AC?TACGTT?TA?TAAAATAA-----  
Consensus