1   A new species of baleen whale (*Balaenoptera*) from the Gulf of Mexico, with a review of its

2   geographic distribution

3

4

5   Patricia E. Rosel[1], Lynsey A. Wilcox[1], Tadasu K. Yamada[2], Keith D. Mullin[3]

6   [1]Southeast Fisheries Science Center, National Marine Fisheries Service, NOAA, Lafayette,

7   Louisiana USA

8   [2]National Museum of Nature and Science, Tsukuba-shi, Ibaraki 305-0005, Japan

9   [3]Southeast Fisheries Science Center, National Marine Fisheries Service, NOAA, Pascagoula,

10   Mississippi USA

11

12   **Correspondence**:

13   Patricia Rosel, Southeast Fisheries Science Center, National Marine Fisheries Service, NOAA,

14   646 Cajundome Blvd., Lafayette, Louisiana 70506

15   Email: patricia.rosel@noaa.gov

16
17
18
19
20

Abstract

Bryde's-like whales are a complex of medium-sized baleen whales that occur in tropical waters

of all three major ocean basins. Currently, a single species of Bryde's whale, *Balaenoptera*

edeni Anderson, 1879, is recognized, with two subspecies, Eden's whale, *B. edeni edeni* and

Bryde's whale, *B. edeni brydei* (Olsen, 1913), although some authors have recognized these as

separate species. Recently, a new, evolutionarily divergent lineage of Bryde's-like whale was

identified based on genetic data and was found to be restricted primarily to the northern Gulf of

Mexico (GOMx). Here, we provide the first morphological examination of a complete skull

from these whales and identify diagnostic characters that distinguish it from the other medium-

sized baleen whale taxa. In addition, we have increased the number of genetic samples of these

Bryde's-like whales in the GOMx from 23 to 36 individuals, all of which matched the GOMx

lineage. A review of Bryde's-like whale records in the Caribbean and greater Atlantic supports

an isolated distribution for this unique lineage, augmenting the genetic and morphological body

of evidence supporting the existence of an undescribed species of *Balaenoptera* from the Gulf of

Mexico.

1 | INTRODUCTION

Despite being some of the largest animals on the planet and carrying the moniker of 'charismatic megafauna', it is always surprising to be reminded that the taxonomy and systematics of cetaceans, even today, remain in flux. Taylor et al. (2017b) surveyed the extant cetacean fauna and concluded that of the currently recognized taxa, 32% have a high likelihood of underclassification errors and that an accurate taxonomy may contain twice the number of subspecies currently recognized. For example, two subspecies of killer whales (*Orcinus orca*) are currently recognized, but recent studies have suggested there are additional unrecognized subspecies or even species (Leduc et al., 2008). Taylor et al. (2017b) concluded that the primary problems encountered when trying to address questions in cetacean taxonomy include the difficulty of obtaining skulls or obtaining tissue samples from elusive, often remote and difficult to sample taxa, coupled with the legal protections they are given. Due to these problems, studies often have inadequate numbers of samples, and/or an inadequate geographic sampling of these typically widely distributed species. As a result, robust taxonomic inference is often severely hindered.

Members of the "Bryde's whale complex" in the genus *Balaenoptera* provide an excellent example of the historical and contemporary confusion that exists in cetacean taxonomy. These tropical and subtropical, and generally nonmigratory whales, are found in all major ocean basins. They are difficult to distinguish visually based on external morphology and are therefore often collectively referred to as the "Bryde's whale complex" or "Bryde's-like whales." Currently a single species of Bryde's whale, *Balaenoptera edeni* Anderson, 1879, is recognized, with two recognized subspecies, Eden's whale, *B. edeni edeni* and Bryde's whale, *B. edeni brydei* (Olsen,

68 1913) (Committee on Taxonomy, 2019). These two subspecies have previously also been

69 considered species based on morphological data (Soot-Ryen, 1961; Wada et al., 2003) and

70 supported by genetic data (Rosel & Wilcox, 2014; Wada et al., 2003); see Rice (1998) for a

71 historical review of differing opinions on the taxonomy of these whales. Genetic analysis of the

72 type specimen for *B. edeni* has not yet been completed and a type specimen was not designated

73 for *B. brydei* when it was named. As a result, despite the multiple lines of evidence for species-

74 level differences, there has been a conservative treatment of the taxonomic rank of these two

75 members and they are both currently recognized as subspecies of *B. edeni* (Committee on

76 Taxonomy, 2019).

77

78 *Balaenoptera edeni* Anderson, 1879 was first described from a medium-sized balaenopterid

79 whale that stranded in Myanmar in 1871 (Anderson, 1878 [1879]). They are thought to inhabit

80 coastal waters of the Indian Ocean and the western Pacific, with genetically confirmed records

81 from the East and South China seas and coastal waters throughout the northern Indian Ocean

82 from Oman east to Indonesia (Jayasankar et al., 2009; Kershaw et al., 2013; Kim et al., 2018; Li

83 et al., 2019; Rosel & Wilcox, 2014; Sasaki et al., 2006; Wada et al., 2003; Yoshida & Kato,

84 1999; Yusmalinda et al., 2017). To date there are no records from the Atlantic basin or the

85 eastern Pacific. *B. brydei* Olsen, 1913 was described based on whales taken by the whaling

86 industry in Saldanha Bay, South Africa (Olsen, 1913). These whales are generally associated

87 with deeper, more pelagic waters and have a much broader worldwide distribution, with

88 genetically confirmed records from the Atlantic, Pacific, and Indian Ocean basins (Alves et al.,

89 2010; Herath, 2007; Kanda et al., 2007; Kershaw et al., 2013; Kim et al., 2018; Luksenburg et

90   al., 2015; Murakami et al., 2018; Pastene et al., 2015; Penry, 2010; Penry et al., 2018; Rosel &

91   Wilcox, 2014; Sasaki et al., 2006; Wada et al., 2003; Yoshida & Kato, 1999).

92

93   As recently as 2003, a new species of Bryde's-like whale was removed from the complex when

94   Wada et al. (2003) described a smaller balaenopterid, Omura's whale, *Balaenoptera omurai*.

95   The authors suggested, based on morphological comparisons of the skull, that *B. omurai* and the

96   two *B. edeni* subspecies each have diagnostic features in the morphology of the vertex of the

97   skull, and that all three should be considered distinct species: *B. omurai*, *B. edeni*, and *B. brydei*.

98   Genetic analyses based on mitochondrial DNA (mtDNA) control region sequence data were

99   consistent with the morphological distinctiveness of all three taxa, returning well-supported,

100   reciprocally monophyletic groupings of the currently recognized *B. omurai*, *B. e. edeni*, and *B. e.*

101   *brydei* (Kershaw et al., 2013; Rosel & Wilcox, 2014; Sasaki et al., 2006). Interestingly, while

102   originally thought to be restricted to the western Pacific and the tropical eastern Indian oceans

103   (Cerchio et al., 2019; Yamada, 2009), Omura's whales have now been recorded from the western

104   and central Indian Ocean (Cerchio et al., 2015; Cerchio et al., 2019), and from the eastern and

105   western tropical Atlantic Ocean, near and south of the equator (Cypriano-Souza et al., 2017;

106   Jung et al., 2016), indicating that the confusion in distinguishing amongst members of this

107   closely related group of whales in the field has dramatically impaired understanding of each

108   member's taxonomy, genetics, and distribution. Cerchio et al. (2019) provide a comprehensive

109   review of the distribution of this species.

110

111   Most recently, Rosel and Wilcox (2014) identified a new, evolutionarily distinct lineage of

112   Bryde's-like whales in the Gulf of Mexico (GOMx) (Fig. 1). The presence of Bryde's whales in

113   the GOMx was first recognized in 1965 (Rice, 1965) based on a whale that stranded alive on

114   April 2, 1965 in the panhandle of Florida and was later towed to sea. Historically, these whales

115   were assumed to be a population of the broadly distributed *B. edeni* species. Analysis of

116   mitochondrial DNA (mtDNA) control region sequences of whales sampled in the northeastern

117   GOMx revealed that this population is evolutionarily distinct from all other whales within the

118   Bryde's whale complex and all other known balaenopterid species (Rosel & Wilcox, 2014).

119   Phylogenetic analyses placed these GOMx whales on a strongly supported lineage separated

120   from *B. e. edeni* and *B. e. brydei* sampled in the Atlantic, Pacific, and Indian Oceans (Rosel &

121   Wilcox, 2014). Within the first 375 base pairs of the mtDNA control region, the whales from the

122   GOMx exhibited 25 fixed differences differentiating them from *B. e. edeni* and *B. e. brydei*

123   (Rosel & Wilcox, 2014). This number of fixed differences is two to three times greater than that

124   observed between recognized right whale species (*Eubalaena* spp.) and is of the same magnitude

125   as the number of fixed differences found between fin (*B. physalus*) and blue (*B. musculus*)

126   whales over the same gene region (Rosel et al., 2017). For further comparison, Archer et al.

127   (2013) found only two fixed differences between the fin whale subspecies in the North Atlantic

128   and North Pacific.

129

130   Rosel and Wilcox (2014) recommended that, based on the significant number of diagnostic

131   differences and the finding of reciprocal monophyly, the whales in the GOMx should be given

132   taxonomic status equivalent to the currently recognized subspecies, but they did not provide a

133   species description. This omission was due largely to the lack of an intact specimen to represent

134   the holotype for the new taxon. In addition, criteria for recognizing species and subspecies of

135   cetaceans based on mtDNA sequence data were also lacking at the time.

136

137   In January 2019, an adult male Bryde's-like whale stranded and died in the Everglades on the

138   southwestern coast of Florida in the GOMx (field number FMMSN1908). The entire specimen

139   was collected and the intact skull and skeleton were deposited into the Smithsonian National

140   Museum of Natural History collection (USNM 594665). In addition, Taylor et al. (2017a)

141   described new guidelines and thresholds for delimiting cetacean subspecies and species using

142   mtDNA control region sequence data. Here we re-examine the genetic distinctiveness of the

143   Bryde's-like whales in the GOMx, adding data from new samples collected since the initial

144   publication of Rosel and Wilcox (2014), new DNA sequence data available from recent

145   publications on Bryde's whales worldwide, and in light of the guidelines and thresholds provided

146   in Taylor et al. (2017a). We also provide a description of the morphological characteristics of

147   the new specimen. The joint genetic and morphological data provide strong support for a new

148   species of *Balaenoptera*.

149

150   **2 | METHODS**

151   **2.1 | Genetic data**

152   Rosel and Wilcox (2014) sequenced the complete mtDNA control region from 18 Bryde's-like

153   whales remotely biopsied in the northeastern Gulf of Mexico (GOMx), three whales that

154   stranded in the GOMx and two that stranded on the U.S. east coast. Here we add new DNA

155   sequence data from 18 new skin samples collected between 2012 and 2019: 14 biopsy samples

156   collected in the northeastern GOMx, the first biopsy sample ever collected in the western GOMx

157   off Texas, and skin collected from two whales that stranded in Louisiana and a whale that

158   stranded in Flamingo, Florida Bay, Everglades National Park. DNA was extracted using a

159   standard proteinase K digestion followed by organic extraction (Rosel & Block, 1996) or a

160   Qiagen DNeasy Blood and Tissue Kit following the manufacturer's instructions. DNA quality

161   and quantity were assessed through gel electrophoresis and fluorometry, respectively. The

162   complete mtDNA control region was amplified and sequenced in two overlapping fragments and

163   the sex of each biopsy was genetically determined as described in Rosel and Wilcox (2014).

164   Control region PCR products were purified via low melting point agarose gel extraction followed

165   by agarose digestion or purified enzymatically using Exonuclease I and FastAP Thermosensitive

166   Alkaline Phosphatase (Thermo Scientific). All PCR products were sequenced in both directions

167   using the Applied Biosystems BigDye Terminator v1.1 cycle sequencing kit and run on an ABI

168   3130 or ABI 3500 Genetic Analyzer or sequenced commercially using a BigDye Terminator

169   v3.1 cycle sequencing kit (Eurofins MWG Operon) on an ABI 3730xl Genetic Analyzer.

170   Forward and reverse reads were independently edited using Sequencher v5.4.6 (GeneCodes) or

171   Geneious Prime 2020.0.5 (https://www.geneious.com) and a final consensus sequence for each

172   sample was assembled.

173

174   In an effort to locate a specimen that could serve as a holotype, we found a specimen at the

175   Louisiana State University Museum of Natural History (LSUMZ 17027) that had been collected

176   in 1954 and identified as a possible Bryde's whale (Lowery, 1974). In order to verify the

177   species, we extracted and sequenced DNA from the specimen. A section of one occipital

178   condyle was cleaned with 5% bleach solution and rinsed with distilled water, and surface bone

179   removed by drilling with a sterile 3 mm drill bit. The drill bit was exchanged for a new sterile

180   bit and bone powder then collected from within the condyle bone. DNA extraction was

181   performed in an ancient DNA only laboratory where all surfaces and laboratory equipment were

182   cleaned with 10% bleach prior to performing the extraction. DNA was extracted from 50 mg of

183   bone powder using the Qiagen QIAamp DNA Investigator Kit after demineralization of the

184   powder in 950 µl of 0.5 M EDTA (pH 8.0) at room temperature for 18 hr. Extraction was

185   performed according to the manufacturer's protocol for isolation of DNA from bone with the

186   following adjustments: Buffer ATL was decreased from 360 µl to 330 µl, Buffer AL with carrier

187   RNA was increased from 300 µl to 700 µl, and the ethanol added prior to binding to the QIAamp

188   MinElute column was increased from 150 µl to 350 µl. A negative DNA extraction control was

189   simultaneously run using 950 µl of 0.5 M EDTA (pH 8.0).

190

191   For this bone sample, the 5' end of the mtDNA control region was amplified and sequenced

192   using five overlapping fragments ranging from 132 to 160 base pair (bp) in length. The

193   following sets of primer pairs were used to obtain control region sequence: L15874 (Vollmer et

194   al., 2011) and Bede143R (5'-ATTAATTAAGTTATAGGAAGGT-3') annealing temperature T_a

195   = 50°C; Bede121F (5'-CTTGTCTTATCACATATTATT-3') and Bede229R (5'-

196   CTTCAACTGCTCGTGGT-3') T_a = 50°C; Bede218F (5'-TGCTATGTATAACTGTGCATTC-

197   3') and Bede310R (5'-GACTGGGGAATGCATAACAG-3') T_a = 45°C; BedeShort145F (5'-

198   ACCACGAGCAGTTGAAGTCC-3') and BedeShort145R (5'-

199   TCGTGATCTAATGGAGCGGC-3') T_a = 55°C; BedeShort89F (5'-

200   TGCTGTTATGCATTCCCCAGT-3') and H16265 (Rosel et al., 1999) T_a = 50°C. Each PCR

201   was performed in a 50 µl reaction with 20 mM Tris-HCl (pH 8.4), 50 mM KCl, 1.5 mM $MgCl_2$,

202   150 µM dNTPs, 2.5 U *Taq* DNA Polymerase (Invitrogen), 0.12 mg/ml BSA, 0.3 µM of each

203   primer and 4 – 5 µl of DNA. The PCR profile included an initial denaturation step of 95°C for

204   30 s followed by 45 cycles of 95°C for 30 s, T_a as listed above for 30 s, and 72°C for 30 s with a

205   final extension at 72°C for 7 min. PCR products were purified using Exonuclease I and FastAP

206   Thermosensitive Alkaline Phosphatase (Thermo Scientific) and sequenced in both directions

207   using the Applied Biosystems BigDye Terminator v1.1 cycle sequencing kit on an ABI 3130

208   Genetic Analyzer. Forward and reverse reads were independently edited using Geneious Prime

209   2020.0.5 and consensus sequences for each fragment were created then assembled to create one

210   continuous sequence of the 5' end of the control region. The final sequence was compared to the

211   control region haplotypes of baleen whales recovered in the GOMx and western North Atlantic.

212

213   The Bayesian phylogenetic analysis presented in Rosel and Wilcox (2014) was repeated with the

214   addition of the new sequences described above and augmented with new sequences from the

215   other Bryde's whale taxa published since 2014 and available in GenBank. The additional

216   published sequences expanded the geographic range of the original phylogenetic analysis to

217   include localities of Bryde's whales, *B. e. brydei*, in the southern Caribbean (Luksenburg et al.,

218   2015), the East China Sea (Kim et al., 2018), the California coast of the eastern North Pacific[1],

219   off the coast of Chile in the eastern South Pacific (Pastene et al., 2015) and the coast of Brazil in

220   the western South Atlantic (Pastene et al., 2015). The geographic range of Eden's whale, *B. e.*

221   *edeni*, was increased by including new sequences from stranded whales in Bali, Indonesia in the

222   eastern Indian Ocean (Yusmalinda et al., 2017) and the South China Sea (Li et al., 2019).

223   Because the published sequences available in GenBank are of varying lengths, we performed the

224   phylogenetic analysis on three different control region alignments: a 305 bp alignment that

---

[1] Unpublished data. M. E. Flannery and A. B. Sellas. Ornithology and Mammalogy, California
Academy of Sciences, 55 Music Concourse Drive, San Francisco. GenBank accession number KY938508.

225   allowed us to include the broadest geographic coverage of the Bryde's whale complex contained

226   73 haplotypes, a 375 bp alignment containing 22 haplotypes and finally a 721 bp alignment

227   containing 11 haplotypes. The latter alignment still allowed for coverage of all members of the

228   Bryde's whale complex and geographic coverage from the North Atlantic (including the GOMx

229   and Caribbean Sea), South Atlantic, North Pacific (including the East and South China Seas),

230   and the South Pacific. The alignments also included haplotypes from *B. omurai* and from other

231   balaenopterid whales, while *Eubalaena glacialis* served as the outgroup (Table S1). All

232   sequences were aligned using MUSCLE v3.8.425 and default parameters in Geneious Prime

233   2020.0.5.

234

235   Phylogenetic analyses were performed on each alignment using MrBayes v3.2.6 (Huelsenbeck &

236   Ronquist, 2001). First, jModeltest v2.1.6 (Posada, 2008) and the Bayesian information criterion

237   (BIC) were used to determine the best model given the control region alignments; TPMuf+G for

238   the 305 and 375 bp alignments and TPM3uf+I+G for the 721 bp alignment. As a result, the

239   more parameterized general time reversible (GTR) model with appropriate corrections (gamma

240   and/or invariable sites) was used. For each alignment, MrBayes was run in Geneious Prime

241   2020.0.5. Bayesian searches used 4 chains, 2 runs, and 5,000,000 generations using default

242   priors in MrBayes. Burn-in was set to 25%. Convergence of the runs was determined by

243   examining the average standard deviation of split frequencies and using Tracer v1.5 (Rambaut &

244   Drummond, 2007).

245

246   A characteristic attributes (CAs) diagnosis (Davis & Nixon, 1992; Lowenstein et al., 2009;

247   Sarkar et al., 2002) was performed using the control region sequences of *B. e. edeni*, *B. e. brydei*,

248   *B. omurai*, and the haplotypes from the GOMx whales for the 305 bp control region alignment

249   using all sequences available in GenBank. While it is the shortest alignment, the 305 bp region

250   allows us to include the greatest number of haplotypes for all taxa involved, thereby improving

251   the likelihood that identified diagnostic sites are reflect true interspecific differences and not

252   simply intraspecific variability.

253

254   Subsequent to the identification of this unique lineage of whales in the GOMx in 2014, standards

255   and guidelines for delimiting cetacean species and subspecies based on mtDNA control region

256   sequences were established by Taylor et al. (2017a). Rosel et al. (2017) surveyed levels of

257   genetic divergence in the mtDNA control region between accepted pairs of species, subspecies,

258   and populations of cetaceans, and explored the efficacy of different metrics of genetic divergence

259   for correctly identifying these different taxonomic levels. They found that the genetic measure

260   of net nucleotide divergence or d_A (Nei, 1987) performed well at distinguishing species from

261   subspecies and populations. This metric provides a measure of number of net nucleotide

262   substitutions or net divergence between two groups, accounting for the level of within group

263   variability. Taylor et al. (2017a) built on these results, recommending quantitative standards for

264   delimiting new species and subspecies based on d_A coupled with a measure of diagnosability

265   (defined as "a measure of the ability to correctly determine the taxon of a specimen of unknown

266   origin based on a set of distinguishing characteristics" (Archer et al., 2017)). If $d_A > 0.02$

267   between two groups of cetaceans, those groups exceed the threshold of net nucleotide divergence

268   consistent with species level differences and could warrant species status when also coupled with

269   a diagnosability of at or near 100%. In cases where $0.004 < d_A < 0.02$ between two taxonomic

270   groups, those groups exhibit levels of genetic divergence consistent with subspecies. To place

271   the degree of divergence of the Bryde's-like whales from the GOMx into this context, we

272   estimated net nucleotide divergence, d_A (Nei, 1987), for both Bryde's whale subspecies,

273   Omura's whale and sei whale, *B. borealis*, sequences of the 375 bp alignment using MEGA X:

274   Molecular Evolutionary Genetics Analysis across computing platforms (Kumar et al., 2018;

275   Stecher et al., 2020). For one haplotype, information on the number of individuals with the

276   haplotype was not provided in the publication and was therefore assigned as a single individual.

277   Fixed differences were calculated using DNAsp v6.12.03 and fixed indels determined by

278   viewing the alignments in Geneious Prime 2020.0.5.

279

280   All of the new samples except for the bone sample (LSUMZ 17027) were genotyped at the 17

281   microsatellite loci identified as polymorphic in Rosel and Wilcox (2014) using a Qiagen Type-it

282   Microsatellite PCR kit and the manufacturer's protocols. The loci used were: GATA028,

283   GATA053, GATA098, GATA417, GGAA520 (Palsbøll et al., 1997), AC137, CA234, GT023,

284   GT122, GT307, GT541 (Bérubé et al., 2005), EV104 (Valsecchi & Amos), Ppho130, Ppho137

285   (Rosel et al., 1999), SW13 (Richard et al., 1996), GM199/200, GM417/418 (Amos et al., 1993).

286   Reverse primers for all loci except GATA028, GATA053, GT023 and Ppho137 were pigtailed

287   following Brownstein et al. (1996). Multiplexing allowed all 17 loci to be genotyped in three

288   PCR reactions (Table S2). All PCR reactions included positive and negative no-DNA controls.

289   Resultant PCR products, including all controls, were genotyped on an ABI 3130 or an ABI 3500

290   Genetic Analyzer using Genescan 500 LIZ or Genescan 600 LIZ v2.0 dye size standard (Applied

291   Biosystems), respectively. The raw data were scored using GeneMapper v6 (Life

292   Technologies/Applied Biosystems). Observed and expected heterozygosities and the number of

293   alleles per locus were calculated using Arlequin v3.5 (Excoffier & Lischer). In order to identify

294   whether multiple biopsies were collected from the same animals, we used Microsatellite Toolkit

295   (Park, 2001) to search for individuals with identical multilocus genotypes and we estimated

296   probability of identity $P_{(ID)}$ and the more conservative $P_{(ID)sib}$ (Waits et al., 2001) using

297   GenAlEx v6.5 (Peakall & Smouse, 2006). Samples identified as having identical genotypes

298   were also checked to see that they had the same sex and the same control region sequence.

299

300   **2.2 | Morphological data**

301   On 29 January 2019, a 1,126 cm adult male Bryde's-like whale (FMMSN1908) stranded in

302   Flamingo, Florida Bay, Everglades National Park, on the southwestern coast of the Florida

303   Peninsula in the GOMx. The Florida Fish and Wildlife Conservation Commission (FWC)-

304   Southwest Field Laboratory coordinated with NOAA National Marine Fisheries Service,

305   Southeast Fisheries Science Center and volunteers from multiple agencies to salvage the carcass

306   for full necropsy and preservation. A suite of external observations was taken by the stranding

307   responders and the carcass was then buried in Fort De Soto Park, Florida. In October 2019, after

308   being moved from Florida to North Carolina for further cleaning, the entire skeleton was

309   exhumed, cleaned further and deposited in the U.S. Museum of Natural History at the

310   Smithsonian Institution (USNM 594665). We took ten measurements of the skull (Table 1) to

311   the closest millimeter using a calipers and photographed the skull. In addition, we examined and

312   compared the characteristics of the vertex of the skull identified by Wada et al. (2003) as

313   important for distinguishing among the different Bryde's whale taxa, including Omura's whale.

314   These include the shape and extent of the ascending process of the posterior end of the maxilla,

315   the extent to which the frontals are exposed, the extension of the premaxilla and whether it

316   reaches the frontal, and whether the alisphenoid and squamosal bones are in contact. We also

317   directly compared these features between this whale (USNM 594665) and USNM 572922, a

318   subadult male that stranded on the North Carolina coast in 2003 that has been genetically

319   confirmed to belong to the lineage that identifies the Bryde's-like whales in the GOMx (Rosel &

320   Wilcox, 2014).

321

322   **2.3 | Distributional data**

323   The National Marine Fisheries Service (NMFS), Southeast Fisheries Science Center (SEFSC)

324   has conducted marine mammal vessel and aerial surveys in the northern GOMx, covering

325   nearshore, continental shelf and slope, and oceanic waters out to the U.S. EEZ since the late

326   1980s. We reviewed and compiled all "Bryde's whale", "*Balaenoptera* sp." and "Bryde's/sei

327   whale" sightings from these GOMx surveys spanning 1989–2019. We similarly compiled and

328   reviewed all NMFS marine mammal vessel and aerial surveys in the U.S. EEZ of the Atlantic

329   coast between 1992 and 2019. Depths at each visual sighting location were extracted using

330   ArcGIS and the ETOPO2 2-arc-minute gridded global relief dataset.

331

332   We also reviewed 13 sightings records provided by the Bureau of Ocean Energy Management

333   (BOEM) made by protected species observers (PSO) on seismic vessels in the GOMx from

334   2010–2014 as part of the required mitigation measures. These observers record time, location,

335   distance to vessel, water depth, species, a visual description of the whale and additional sighting

336   details for each sighting. As other whales are present in the GOMx, including sperm whales and

337   beaked whales (Family Ziphiidae), which, at a distance, could potentially be confused with a

338   baleen whale, we evaluated each sighting description to determine the likelihood the sighting

339   was of a Bryde's-like whale.

340

341   Finally, we reviewed stranding data from the U.S. GOMx coast and the U.S. Atlantic seaboard

342   for those strandings listed as "Bryde's whales" through query of the NOAA National Marine

343   Mammal Health and Stranding Response Database and the Division of Mammals Collections at

344   the Smithsonian National Museum of Natural History (USNM), including examination of all

345   written records in the USNM archive. While stranding data can potentially provide some

346   information on cetacean distribution, it is important to recognize that stranding location may not

347   always represent habitat or area of origin due to currents and winds moving carcasses away from

348   normal distribution. We also reviewed the published literature for both regions and also

349   broadened the search to cover the entire Atlantic Ocean to further evaluate the distribution of

350   Bryde's whale taxa in the Atlantic Basin.

351

352

353   **3 | Results**

354   **3.1 | Genetic data**

355   The full mtDNA control region (936 bp) was successfully sequenced for 15 new remote skin

356   biopsy samples and three strandings. No new haplotypes were found; all new animals exhibited

357   the most common haplotype (Bede001, GenBank accession KJ586818). The 5' end of the

358   mtDNA control region (381 bp) that was sequenced for bone sample LSUMZ 17027 also

359   matched the Bede001 haplotype. In combination with those samples presented in Rosel and

360   Wilcox (2014), a total of 42 whale tissue samples (35 biopsies, 7 strandings) have been analyzed

361   from the GOMx and two strandings from the Atlantic.

362

363   All tissue samples were successfully genotyped at the 17 microsatellite loci. Only a single new

364   allele was found at locus GATA098, despite increasing the overall genotyped sample size by 59

365   %. Probabilities of identity (P_{ID} = 1.50 x 10^{-4}; $P_{ID(sib)}$ = 1.36 x 10^{-2}) were relatively high due to

366   the low heterozygosity exhibited by all the loci (Table S2). Microsatellite Toolkit identified 8

367   duplicate samples across the pooled old and new sample set, with several animals biopsied eight

368   to nine years apart. After removing duplicate samples, and including the LSU specimen, the

369   total number of individual whales sampled in the northern GOMx and the two strandings on the

370   east coast between 1954 and 2019 is 36. The sex ratio across these unique individuals (biopsies

371   and strandings) is 19F:15M; the sex of two stranded animals could not be determined.

372

373   The Bayesian analyses based on the mtDNA control region alignments revealed the same pattern

374   found previously (Rosel & Wilcox, 2014). *B. e. edeni*, *B. e brydei*, and the Bryde's-like whales

375   in the GOMx are each reciprocally monophyletic with posterior probabilities of 0.99 to 1.0 (Fig.

376   2, Figures S1, S2). The characteristic attributes diagnosis on the 305 bp control region alignment

377   identified a total of 30 diagnostic sites that distinguish among *B. e. brydei*, *B. e. edeni*, *B. omurai*,

378   and the Bryde's-like whales from the GOMx (Table 2). These include 24 of the 25 diagnostic

379   sites reported in Rosel and Wilcox (2014) and five additional sites previously described in

380   Cypriano-Souza et al. (2017). Nucleotide position 15682 was counted in error in Rosel and

381   Wilcox (2014) as a diagnostic position. A novel diagnostic site for the Bryde's-like whales from

382   the GOMx not previously noted (position 15564) was identified due to removal of one *B. e.*

383   *brydei* haplotype (GenBank accession EF068039) due to sequencing error reported by the

384   authors[2]. The total number of diagnostic positions for each of the four taxa was: *B. e. edeni* (n =

385   2), *B. e. brydei* (n = 3), *B. omurai* (n = 16), and Bryde's-like whales from the GOMx (n = 10).

386   Nei's net nucleotide divergence, d_{A}, between the whales from the GOMx and the two *B. edeni*

387   subspecies based on the 375 bp alignment ranged from 0.103 to 0.128 (Table 3), significantly

388   greater than the minimum value of 0.02 for species level distinction identified by Taylor et al.

389   (2017a). The number of fixed differences likewise remains high between the whales from the

390   GOMx and those elsewhere (Table 3) and provide 100% diagnosability based on this gene

391   region.

392

393   **3.2 | Morphological data**

394   The whale that stranded in January 2019 was an adult male (Fig. 3). Total length was 1,126 cm.

395   The whale was a uniform dark gray on the dorsal side with a large falcate dorsal fin; the flippers

396   were uniformly dark. The ventral side was lighter in coloration, particularly on the ventral side

397   of the peduncle. The ventral side of the tail was lighter in color, particularly towards the middle

398   and at the peduncle. Three ventral pleats extended past the umbilicus at the midline. The pleats

399   were counted from the right lateral aspect to the mid-line; in line with the flipper insertion, 27

400   pleats were counted, given a total count of 54 pleats. As is typical for all Bryde's-like whales,

401   three ridges were present on the rostrum.

---

[2] L. Pastene, pers comm. Institute of Cetacean Research, Tokyo, Japan. February 2020

402

403   Wada et al. (2003), Yamada et al. (2006), and Yamada et al. (2008) utilized several diagnostic

404   characteristics of the skull to distinguish between $B. e. edeni$, $B. e. brydei$, and $B. omurai$.

405   Omura's whales exhibit the most differences, including two foramina on the parieto-squamosal

406   suture. $B. e. edeni$ is unique in the shape of the ascending process of the maxilla (slender and

407   round) and in the broadly exposed frontal bones and the 'pedestal' they form for the ascending

408   process of the maxilla (Wada et al., 2003). We utilized the diagnostic characters indicated by

409   Wada et al. (2003), Yamada et al. (2006); Yamada et al. (2008) to examine the skull of the 2019

410   stranded whale (USNM 594665). The foramina seen in Omura's whale were not present in the

411   2019 stranded whale (USNM 594665). The Bryde's-like whales from the GOMx are further

412   distinguished from $B. omurai$ by the posterior end of the premaxillae, which reach the frontals in

413   the GOMx whales but not in $B. omurai$. In the GOMx whales, the frontals are only narrowly

414   exposed, forming a thin, narrow belt, clearly distinguishing them from $B. e. edeni$. In these

415   characteristics of the vertex of the skull, the GOMx whales are most similar to $B. e. brydei$.

416   However, we identified several characteristics in the vertex consistent in both the 2019 specimen

417   (USNM 594665) and the immature whale specimen collected in North Carolina (USNM 572922)

418   that are unique to the Bryde's-like whales from the GOMx and can be used to separate them

419   from the other Bryde's whale subspecies and from $B. omurai$. We observed that the anterior

420   portion of the frontal bones wraps around the posterior end of the nasals and protrudes on their

421   medial side to separate the posterior end of the nasals. In addition, the posterior end of the nasals

422   curves laterally and has relatively smooth margins, while in $B. e. brydei$ the posterior end of the

423   nasals remains straight and has somewhat crenulated margins.

424

3.3 | Distributional data

3.3.1 Gulf of Mexico

Compilation of 181 visual sightings from NMFS marine mammal aerial and vessel surveys between 1989 and 2019 indicates these whales currently have a restricted distribution along the continental shelf break near the De Soto Canyon area of the northeastern GOMx (Fig. 4). The water depths of visual sightings ranged from 117 m to 408 m with all but two in the range of 151–352 m. In addition, a whale tagged in this area in October 2010 was satellite-tracked for a month, during which time the animal remained in waters between 100 and 400 m depth within the northeastern GOMx (Soldevilla et al., 2017).

During this survey period (1989–2019), two of the 181 sightings were of a large baleen whale (recorded as *Balaenoptera* sp. or Bryde's/sei whale) in the western GOMx west of the Mississippi River delta in waters less than 300 m deep, but neither could be identified to species. However, in August 2017, the first confirmed sighting of a live Bryde's-like whale in the western GOMx was made during a NMFS vessel survey (National Marine Fisheries Service, 2018). This whale was seen off the Texas coast in 225 m water depth. Analysis of the mtDNA control region from a skin biopsy sample collected from the whale confirmed that it belongs to the lineage unique to Bryde's-like whales from the GOMx. Finally, acoustic moorings placed in the western GOMx south of Louisiana have recorded some unique vocalizations thought to belong to Bryde's-like whales from the GOMx[3]. Both the recordings and the sighting in the

---

[3] M. Soldevilla, pers comm. NMFS Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, Florida, 33149. July 2019.

445   western GOMx were in water depths similar to the habitat used by the whales in the northeastern

446   GOMx.

447

448   Examination of 13 sightings provided by BOEM from marine mammal observers on seismic

449   vessels provided only minimal insight. No sightings were close enough for observers to record

450   whether the diagnostic lateral ridges on the dorsal surface of the head were visible and thus none

451   could unequivocally be identified as a Bryde's-like whale. Five sightings were in water depths

452   >1,000 m, which is inconsistent with the Bryde's-like whales in the GOMx, and several of these

453   observations described surfacing followed by multiple blows, a behavior more consistent with

454   sperm whales recovering after a deep dive. These five sightings were ruled out as likely baleen

455   whale sightings. Two sightings were within the known habitat in the northeastern GOMx, in

456   waters of an appropriate depth suggesting they were likely Bryde's-like whales. Two sightings

457   had useful photographs indicating a baleen whale with a distinctive falcate dorsal fin and were

458   likely either a Bryde's whale or a stray sei whale. The four remaining sightings were in depths

459   consistent with Bryde's whales, and several of these had descriptions of behavior consistent with

460   them as well, e.g., two or more vertical blows before diving. These four sightings could not be

461   ruled out based on the available information. While significant uncertainty remains with respect

462   to the identity of whales sighted by PSO observers, four of the sightings were made along the

463   continental shelf break west of the Mississippi River Delta (Fig. 4).

464

465   3.3.2 Atlantic Ocean

466   There are no confirmed at-sea sightings of any type of Bryde's whale along the U.S. eastern

467   seaboard during NMFS marine mammal vessel and aerial surveys between 1992 and 2019,

468   despite considerable survey effort in the U.S. EEZ from Florida through Maine (~854,721 km of

469   on-effort track line surveyed). There were five ship-based and one aerial survey-based sightings

470   recorded as "Bryde's/sei whales" from the early 1990s (Fig. 4). None of these sightings were

471   close enough to identify rostral ridges and five were in waters greater than 1,000 m suggesting

472   they were either the pelagic form of Bryde's whale (*B. e. brydei*) or were sei whales. The

473   southernmost sighting of a Bryde's/sei whale in the Atlantic was in approximately 1,100 m water

474   depth over the Blake Plateau east of central Florida, again much deeper than typical of the

475   GOMx whales. Using 23 years of visual survey data from 1992-2014, Roberts et al. (2016) built

476   habitat-based spatial density models for multiple cetacean species in U.S. waters of the western

477   North Atlantic and GOMx. For the U.S. east coast, the authors utilized data collected from a

478   variety of vessel- and aerial-based line transect surveys covering 895,000 km of effort from

479   southern Florida to the Bay of Fundy. They predicted a mean monthly abundance of seven

480   Bryde's whales (C.V. = 0.58) along the entire eastern seaboard based on four Bryde's/sei whale

481   sightings recorded on these surveys (Roberts et al., 2016).

482

483   Acoustic studies have also not recorded whale call types associated with any type of Bryde's

484   whale in the waters off Jacksonville, Florida, although fin, minke, *B. acutorostrata*, and sei

485   whale vocalizations were detected (Frasier et al., 2016). Further north off Cherry Point, NC and

486   in Norfolk Canyon, acoustic monitoring has detected several baleen whale species, but to date no

487   Bryde's whales have been recorded (Debich et al., 2014; Rafter et al., 2018). Overall, the

488   evidence to date indicates Bryde's whales are extremely rare in U.S. waters of the western North

489   Atlantic.

490

491   Of great interest is whether the Bryde's-like whales from the GOMx are distributed outside of

492   the GOMx in the Caribbean. In other areas of the western Atlantic, Bryde's whales have been

493   recorded off Brazil (de Moura & Siciliano, 2012; Gonçalves et al., 2016; Lodi et al., 2015;

494   Maciel et al., 2018), Suriname (de Boer, 2015) and north to at least Venezuela (Romero et al.,

495   2001; Smultea et al., 2013), and into the southern Caribbean including waters of Bonaire (Debrot

496   et al., 1998), Aruba (Luksenburg et al., 2015), and Curacao (Debrot, 1998; Debrot et al., 1998).

497   Luksenburg et al. (2015) genetically identified the Aruba strandings as *B. e. brydei* and found

498   they were genetically closest to the whales sampled off Madeira in the eastern Atlantic. Whales

499   stranded in Brazil have also been genetically confirmed as *B. e. brydei* (Pastene et al., 2015).

500   Finally, there is a record of a live stranded Bryde's whale (subspecies unknown) from St.

501   Vincent and the Grenadines in 2009[4].

502

503   There are no comprehensive Caribbean-wide cetacean diversity studies from which to draw, and

504   no Caribbean strandings north of Aruba have been genetically tested. However, based on

505   existing sighting information it appears there is a hiatus of Bryde's whales in the central

506   Caribbean, with *B. e. brydei* present in waters south of the hiatus and any Bryde's whale taxon

507   generally rare north of it. A ship-board survey for cetaceans in 2000 covered waters from Puerto

508   Rico to Venezuela (excluding Antigua and Barbuda, Dominica, and St. Vincent and the

509   Grenadines) and recorded five Bryde's whale sightings, all in the southeastern Caribbean

510   (Swartz & Burks, 2000), but which subspecies was seen is unknown. Similarly, Yoshida et al.

511   (2010) surveyed from St. Kitts and Nevis south to Grenada and observed six Bryde's whales

512   (subspecies unknown), all restricted to the southern survey area. One sighting was made in

[4] Eastern Caribbean Cetacean Network. 2010. Marine Mammal Stranding Newsletter 2:7.

513   shallow waters northeast of Grenada while the remaining sightings were made in deep waters

514   (2,000 m) of the Grenada and the Tobago basins. Additional surveys in the northern Caribbean

515   have not recorded any subspecies of Bryde's whales (Roden & Mullin, 2000; Swartz et al.,

516   2002).

517

518   Debrot et al. (2013) compiled cetacean records for the Dutch Windward Islands (Saba, St.

519   Eustatius, St. Maarten, and the Saba Bank) and noted a surprising lack of records of any Bryde's

520   whales. The authors suggested they may be absent from the northeastern Caribbean, a result in

521   agreement with results from the shipboard surveys.

522

523   In the eastern Atlantic Ocean, Bryde's whales have been reported from the offshore islands of

524   Cape Verde (Hazevoet & Wenzel, 2000), Madeira (Alves et al., 2010), and the Azores (Steiner et

525   al., 2008). They also inhabit nearshore waters and offshore waters of the southwestern African

526   coast (Best, 2001; Weir, 2010). To date, the whales in these regions have been genetically

527   ascribed to Bryde's whales, *B. e. brydei*, (Luksenburg et al., 2015; Penry et al., 2018; Rosel &

528   Wilcox, 2014), with the exception of whales in the Azores and the Gulf of Guinea, which have

529   not yet been genetically tested. Thus, to date, these studies have supported the conclusion by

530   Rice (1998) that Eden's whale (*B. e. edeni*) is not present in the Atlantic.

531

532   3.3.3 Stranding data

533   After compiling the available data from stranding reports from the GOMx and the U.S. Atlantic

534   coast, we found 33 records that could potentially be Bryde's -like whales, 24 in the GOMx and 9

535   in the Atlantic. We removed two of the GOMx records we identified as either duplicate records

536 or misidentifications (or both) (Table S3), leaving 22 stranding records in the GOMx listed as

537 "Bryde's whale," dating as far back as 1954; of these, 11 were found in Louisiana at or east of

538 the Mississippi River Delta, nine were collected along the GOMx coast of Florida, including the

539 Everglades, and two were collected in western Louisiana (Fig. 4). Two stranded animals were

540 recorded in the 1970s, seven in the 1980s, and four in 1990s, while three were recorded in the

541 2000s and four in the 2010s. The remaining two were recorded in 1954 and 1965. We

542 characterized the 22 strandings further (Table 4) as 1) "verified GOMx Bryde's-like whale"

543 when diagnostic DNA sequence data were retrieved from the specimen, 2) "Bryde's-like whale"

544 when stranding records included photos or written records indicating rostral ridges were present,

545 but no genetic data were available, or 3) "unconfirmed Bryde's-like whale" when, although the

546 stranding was recorded as a Bryde's whale, we could not find records (photos, written notes)

547 indicating rostral ridges were present and no tissues were available. Whales in category 2 are

548 most likely GOMx Bryde's-like whales as we have found no genetic evidence for any other

549 Bryde's-like whale subspecies in the GOMx, and there is little reason to doubt the records from

550 category 3 as being GOMx Bryde's-like whales, but we chose to be conservative in our

551 verification process. Following this categorization, we had tissue from seven and were able to

552 confirm the mtDNA control region haplotype diagnostic of the Bryde's-like whales from the

553 GOMx in all seven, including the 1954 skull collected by Lowery (1954). Six Gulf strandings

554 had photos that clearly showed rostral ridges indicative of all members of the Bryde's whale

555 complex, but no tissue was available for genetic analysis. The remaining nine could not be

556 verified further than "baleen whale" following our conservative methods. Seven of those

557 stranded in the northern GOMx in Louisiana, along the panhandle of Florida, or near Tampa,

558 Florida where verified GOMx whale strandings are most common, suggesting it is likely these

559   were also GOMx Bryde's-like whales. Interpretations for the other two, one stranding in Big

560   Pine Key, Florida and the other in western Louisiana, are more difficult.

561

562   In the Atlantic, six of the nine records of "Bryde's whale" strandings included sufficient

563   information to verify the animals were from the Bryde's whale complex, either because the

564   records stated that photos were available to confirm rostral ridges or the skull or tissue was

565   collected. Two of these six were confirmed genetically to match the Bryde's-like whales from

566   the GOMx, having the diagnostic mtDNA control region haplotype. Three other records listed as

567   Bryde's whale could not be confirmed either because decomposition of the carcass precluded

568   observation of characteristic features of Bryde's whales or because the stranded animal was not

569   documented well enough. Interestingly, all nine whales were relatively small; all but one was

570   less than 1,000 cm in length (Table 4). Mead (1977) has suggested that the Bryde's whale

571   strandings along the U.S. Atlantic were likely extralimital strays from the Gulf of Mexico.

572

573   In addition to the records for the southern Caribbean mentioned previously, there are five

574   stranding records for Bryde's whales in the northern Caribbean but the subspecies of each is

575   unknown. These include a stranded Bryde's whale in Puerto Rico reported in Mignucci-

576   Giannoni et al. (1999) and a record in the Division of Mammals Collections at the Smithsonian

577   National Museum of Natural History of a stranding in the Bahamas on March 4, 2000 (STR

578   12575) listed as "*B. edeni*?". There is a second record of a Bryde's whale stranding in the

579   Bahamas in 2008 (Currie et al., 2019), and both the USNM database and the Southeast U.S.

580   stranding database reference a May 1991 stranding of a Bryde's whale in St. Croix, Lesser

581   Antilles (MME7994, SE6423). Additional information to verify these records was not found.

582   Whitt et al. (2011) reviewed records of marine mammals in Cuban waters and indicated one

583   confirmed record of a Bryde's whale stranding from the southeastern coast of Cuba, but the

584   subspecies is unknown. This animal was initially identified as a juvenile sei whale by Varona

585   (1965). Mead (1977) re-classified it as a Bryde's whale as the bristles of the baleen were

586   considered too coarse to be from a sei whale, although reports indicated no accessory ridges on

587   the rostrum. Varona (1973), as reported in Whitt et al. (2011), suggested that sei whales were

588   historically found off southeastern Cuba in the 1800s but it is possible these were

589   misidentifications of Bryde's whales (Whitt et al., 2011).

590

591

592   **4 | DISCUSSION**

593   Rosel and Wilcox (2014) revealed, based on a genetic analysis of mtDNA control region

594   sequences compiled from a worldwide distribution, that the Bryde's-like whales found in the

595   northern GOMx were evolutionarily distinct from all other lineages and indicated that they may

596   deserve taxonomic status on par with the other members of the Bryde's whale complex, $B. e.$

597    $edeni$ and $B. e. brydei$. Augmenting this study with additional samples from the GOMx for

598   genetic analysis and with the first morphological analysis an intact specimen from the GOMx

599   further supports that these whales are taxonomically unique. The new morphological data

600   provide a second, independent line of evidence as recommended for delimiting cetacean species

601   (Reeves et al., 2004).

602

603   Several characteristics of the bones of the vertex of the skull distinguish the whales in the GOMx

604   from all members of the Bryde's whale complex. They are clearly distinguished from Omura's

605   whales by the extent of the premaxilla, which do reach the frontal bones in the whales from the

606   GOMx but not in Omura's whales. Bryde's-like whales from the GOMx are easily distinguished

607   from Eden's whales, $B. e. edeni$, by fact that the frontals are only narrowly exposed between the

608   ascending process of the maxilla and the supraoccipital. Finally, like $B. e. edeni$ and $B. e. brydei$,

609   the whales from the GOMx exhibit their own diagnostic shape of the nasal bones, and exhibit the

610   unique feature of frontal bones wrapping around the smooth, curved posterior tips of the nasal

611   bones and extending down in between the nasal bones, forcing a bigger gap between them than

612   seen in the other subspecies. These features allow separation of Bryde's-like whales in the

613   GOMx from Omura's whales and the two recognized subspecies of Bryde's whales.

614

615   Analysis of 18 new soft tissue samples and 1 bone sample, almost doubling the sample size used

616   in the original analysis (Rosel & Wilcox, 2014), did not change the outcomes of the mtDNA

617   genetic analysis or conclusion that these whales are genetically divergent from other whales in

618   the genus *Balaenoptera*. Following the guidelines and standards for delimiting cetacean species

619   and subspecies proposed by Taylor et al. (2017a), we find that the whales in the GOMx

620   substantially exceed the recommended threshold for species for net nucleotide divergence (i.e.,

621   $d_A > 0.02$). When compared to the two recognized subspecies of Bryde's-like whales and to the

622   sei whale, values of d_A for Bryde's-like whales in the GOMx ranged from 0.10 to 0.13 (10 % -

623   13 %) based on the first 375 bp of the mtDNA control region (Table 3). This level is equivalent

624   to that seen between the two currently recognized subspecies of Bryde's whales ($d_A = 0.10$).

625   Thus, the whales from the GOMx are as divergent as the currently recognized subspecies are

626   from each other (and all three exceed the threshold for species). Taylor et al. (2017a) also

627   recommended that, at the species level, two taxa must be diagnosably distinct, and specifically

628   that there is a near 100% probability of identifying an individual as belonging to the taxon.

629   Fixed nucleotide differences in the control region, such as exist between Bryde's-like whales

630   from the GOMx and all other whales, serve to render them diagnosably distinct (100%), further

631   meeting the quantitative criteria of being a separate species. Given the larger number of fixed

632   differences in the control region (Table 3), additional mtDNA data, such as whole mitogenomes,

633   is not likely to alter the diagnosability of these whales. In fact, Rosel and Wilcox (2014)

634   identified multiple fixed differences in the cytochrome *b* and cytochrome oxidase I genes as

635   well. For further perspective, Penry et al. (2018) compared mtDNA control region sequences

636   from inshore and offshore ecotypes of Bryde's whale, *B. e. brydei*, off South Africa. Based on a

637   1.8 – 2.1% divergence and ten fixed differences, they concluded the two ecotypes off South

638   Africa represent different subspecies. The values for both metrics are an order of magnitude

639   lower than those observed between the Bryde's whales-like in the GOMx and the two recognized

640   subspecies, further illustrating the significant evolutionary divergence exhibited by the whales in

641   the GOMx.

642

643   Phylogenetic analysis of the control region sequences continues to identify Bryde's-like whales

644   from the GOMx as a unique lineage separated from the two Bryde's whale subspecies and from

645   the sei whale and Omura's whale with strong support (Fig. 2). What the control region sequence

646   data do not clearly answer is to which of the two subspecies these whales are most closely

647   related. Posterior probabilities on the nodes joining the clades representing each taxon are very

648   low, and in fact the phylogenetic tree based on the 375 bp alignment creates a trichotomy of the

649   sei whale, *B. e. brydei,* and a joint *B. e. edeni* + GOMx whale clade, which itself has a posterior

650   probability of only 0.61, well below the threshold (0.90-0.95) recognized for robust conclusions

651   concerning phylogenetic relationships (Huelsenbeck & Rannala, 2004). This result is not

652   uncommon for the control region, which performs well at identifying unique taxonomic groups

653   and, for instance is useful for DNA barcoding of cetacean species (Viricel & Rosel, 2012), but

654   has been shown to have limitations in identifying evolutionary relationships among recently

655   diverged cetacean taxa (e.g., Perrin et al., 2013). Further analyses utilizing a larger data set that

656   includes nuclear DNA sequences will provide a more robust investigation of the evolutionary

657   relationships among these taxa.

658

659   In addition to genetic and morphological data, Bryde's-like whales in the GOMx also have a

660   unique acoustic signature that distinguishes them from all other baleen whales. Rice et al. (2014)

661   recorded acoustic calls using marine autonomous recording units (MARUs) placed in the known

662   whale habitat in the northeastern GOMx. Three types of sounds were recorded that were

663   consistent with other baleen whale species, but none matched known sounds produced by other

664   baleen whales, including the two Bryde's whale subspecies, suggesting these whales in the

665   GOMx exhibit a unique and diagnostic acoustic repertoire; however, because the recorders were

666   autonomous, it was not possible to directly link the recorded sounds to visual sightings of the

667   whales (Rice et al., 2014). Širović et al. (2014) definitively identified a call-type directly

668   associated with Bryde's-like whales in the GOMx through visual observation paired with towed

669   acoustic-array recordings. More recently, long moans and downsweep pulse trains were

670   validated to be from these whales in the GOMx using real-time visual and acoustic observations[5].

---

[5] M. Soldevilla, pers comm. National Marine Fisheries Service 75 Virginia Beach Drive, Miami Fl, 33149. April 2019

671

672   A workshop on the taxonomy of cetaceans concluded that a single line of evidence (e.g., genetic

673   data or morphological data) was sufficient to delimit cetacean subspecies while two independent

674   lines of evidence were necessary for delimiting species (Reeves et al., 2004). Bryde's-like

675   whales in the GOMx exhibit two strong lines of evidence that distinguish them from all other

676   closely related species. Examination of morphological features of the skull key to discriminating

677   among taxa in the Bryde's whale complex and Omura's whale (Wada et al., 2003), revealed

678   multiple diagnostic characters that distinguish the whales in the GOMx from both $B.\,e.\,edeni$ and

679     $B.\,e.\,brydei$, and from Omura's whale. Similarly, the degree of genetic divergence between the

680   whales in the GOMx and $B.\,e.\,edeni$ and $B.\,e.\,brydei$ ($d_A > 0.10$) significantly exceeds the net

681   divergence metric identified by Taylor et al. (2017a) for species delimitation based on mtDNA

682   control region sequences ($d_A > 0.02$), and multiple diagnostic sites in the mitochondrial sequence

683   further support divergence at the species level. The apparent highly restricted range and

684   isolation of these whales in the northern GOMx reinforces a severely limited opportunity for

685   gene flow with any other populations of Bryde's whales, and the morphological differences rule

686   out recent or ongoing male-mediated gene flow. The data presented here from multiple lines of

687   evidence (genetics, morphology, distribution) indicate that the Bryde's-like whales in the GOMx

688   are a previously unnamed species.

689

690   **4.1 | Distribution**

691   The Bryde's-like whales in the GOMx are the only year-round resident baleen whale species in

692   the GOMx. Sightings and strandings of all other baleen whale species in the GOMx are rare and

693 considered extralimital (Jefferson, 1995; Jefferson & Schiro, 1997). Compiling the sighting,

694 acoustic, genetic, and stranding data, it is clear that these whales are restricted in their

695 distribution to the GOMx, and that the northeastern GOMx, particularly the De Soto Canyon area

696 and water depths of 150–410 m, are currently the primary habitat of these whales. The nearest

697 confirmed populations of other members of the Bryde's whale complex are of *B. e. brydei* in the

698 southern Caribbean south to Venezuela and Brazil, and in the eastern North Atlantic and the

699 eastern south Atlantic off South Africa (Alves et al., 2010; Best, 2001; de Boer, 2015; de Moura

700 & Siciliano, 2012; Debrot, 1998; Debrot et al., 1998; Gonçalves et al., 2016; Hazevoet et al.,

701 2010; Hazevoet & Wenzel, 2000; Luksenburg et al., 2015; Maciel et al., 2018; Pastene et al.,

702 2015; Penry et al., 2018) (Fig. 5). To date there are no confirmed records of *B. e. edeni* from the

703 Atlantic basin.

704

705 LaBrecque et al. (2015) identified biologically important areas (BIAs) for cetacean species in the

706 GOMx, including waters 100–300 m deep in an area in the northeastern GOMx for the GOMx

707 whale [See Fig. 3.1 in LaBrecque et al. (2015)]. We have revisited and updated this area using

708 additional years of sighting data to better reflect the currently known distribution in the

709 northeastern GOMx (Figs. 4, 5). A convex hull polygon (IUCN, 2012) was drawn around all

710 visual sightings recorded as "Bryde's whale", "Bryde's/sei whale" or "balaenopterid whale" (the

711 latter are cases where the characteristic rostral ridges of a Bryde's whale were not noted),

712 telemetry tag locations (n = 52) from a single Bryde's-like whale tagged in 2010 (Soldevilla et

713 al., 2017) in the northeastern GOMx, and Acousonde tag locations (n = 41) for one whale tagged

714 in 2015 (Soldevilla et al., 2017); a total of 212 data points collected between 1989 and 2018.

715 The convex hull polygon was trimmed at 410 m, determined based on the current deepest known

716 sighting of 408 m. By its very nature, many of the sightings fall on the boundary of the convex

717 hull polygon and therefore the polygon under-estimates the range of the species and was further

718 buffered to account for uncertainty in the distribution. A 10 km buffer was drawn around this

719 polygon to capture the uncertainty in sighting position given the strip width of the vessel surveys.

720 An additional 20 km buffer was then added to this "position uncertainty" to account for the likely

721 movement of observed whales. This results in a 30 km buffer around sighting locations. The

722 area should be updated periodically with new sighting data as they become available.

723

724 As mentioned above, there was a confirmed sighting of a Bryde's-like whale in the western

725 GOMx in 2017 and there were two baleen whale sightings (only identified as "Bryde's/sei

726 whale") during NMFS surveys in the western Gulf in the early 1990s. These sightings raise

727 important questions. Is it possible that some whales move west from the current core habitat in

728 the northeastern GOMx? Alternatively, do these sightings constitute remnants of a once more

729 broadly distributed population, as suggested by whaling data (Reeves et al., 2011) and if so, why

730 are they now rare in the western GOMx? Or do they come from another, as yet unidentified

731 population in the southern GOMx? Has this area in the western GOMx become a marginal or

732 suboptimal habitat for these whales? Further research in the western and southern GOMx will

733 greatly aid our understanding of whether these whales utilize these habitats and if so, how often,

734 and also how they are related to the whales that are found in the northeastern GOMx.

735

736 **4.2 | Life History**

737 Little is known about the life history of these whales in the GOMx. Stranding and biopsy data

738 indicate both sexes are present in the Gulf; the sex ratio determined for 32 individual whales

739   from the northern GOMx was 18 females and 14 males (not significantly different from a 50:50

740   ratio, Chi-square with 1 degree of freedom, P = 0. 4795). In addition, stranding data indicate the

741   whales are likely breeding in the GOMx, as we identified records of several smaller animals in

742   the stranding records, including a 470 cm calf that stranded alive in November of 2006, and a

743   693 cm individual that stranded in November of 1988 and was brought into captivity for a short

744   time (Edds et al., 1993). In August 2016, two whales were sighted together in the northeastern

745   GOMx core area during a NMFS SEFSC large-vessel survey. One whale was approximately

746   half the size of the larger whale and had physical characteristics suggestive of a calf. In addition,

747   a dead, lactating female whale was found in Tampa Bay in October of 2009. This whale

748   mortality likely resulted from a ship strike as the whale exhibited internal injuries consistent with

749   blunt force trauma.

750

751   Basic information on total length, standard external measurements, external color pattern, etc.

752   suffers from inadequate sample sizes. After re-examining records for strandings recorded as

753   "Bryde's whales" in the GOMx and western North Atlantic, and removing those we determined

754   to be mis-identified or duplicate records, some external measurements were available in common

755   across eight whales (Table S4). Total length measurements for these whales ranged from 470 cm

756   to 1,265 cm.

757

758   Worldwide, members of the Bryde's complex exhibit a variety of foraging strategies and prey

759   preferences, often with observations of surface feeding. Overall, pelagic schooling fishes in the

760   order Clupeiformes (sardines, herring, menhaden, anchovies) are the most commonly recorded

761   prey, along with similar schooling species such as members of the family Carangidae (Best,

762   2001; Konishi et al., 2009; Murase et al., 2007; Siciliano et al., 2004; Tershy, 1992; Watanabe et

763   al., 2012). Populations examined further offshore also target euphausiids (Best, 2001; Konishi et

764   al., 2009), while the *B. e. brydei* population of the Hauraki Gulf in New Zealand appears to prey

765   on copepods and krill along with ray-finned fishes and salps (Carroll et al., 2019). However, diet

766   is poorly characterized for the whales in the GOMx. Surface feeding has never been observed.

767   Recently, Soldevilla et al. (2017) placed an Acousonde suction-cup tag on a Bryde's-like whale

768   in the northeastern GOMx. The tag remained attached for nearly three days (63.85 h) in October

769   2010 and revealed a diel diving pattern. During the night, the whale remained near the surface,

770   88% of the time within 15 m of the surface. Daytime dive behavior was characterized by

771   repeated deep dives to depths >200 m, likely at or near the seafloor. Some of these deep dives

772   included lunges near the seafloor associated with foraging (Soldevilla et al., 2017). This type of

773   bottom feeding is unusual for members of the complex. It is not known what they may have

774   been feeding on at those depths. Lanternfish (Myctophidae) and hatchetfish (Sternoptychidae)

775   are abundant members of pelagic waters of the GOMx (Ross et al., 2010; Stickney & Torres,

776   1989), and some species may serve as prey. Further work to identify primary prey species and

777   foraging behaviors is needed and will be important for identifying potential threats and important

778   habitat for these whales.

779

780   Finally, estimates of abundance for the whales in the northern GOMx are under 100 individuals.

781   Broad-scale aerial and ship-based line transect surveys to estimate cetacean abundance have been

782   conducted in the northern GOMx as far back as 1991. Eleven abundance estimates have been

783   made between 1991 and 2009 and range between zero and 44 [See Rosel et al. (2016) for

784   summary of surveys]. Surveys with the lowest estimates covered waters primarily of the western

785   GOMx, supporting their rarity in this region. It should be noted, however, none of these surveys

786   were focused on estimating abundance of a rare species and precision of all estimates is poor.

787   The current best estimate of abundance is 33 (CV = 1.07) (Waring et al., 2015). Future work

788   dedicated to estimating abundance within the known habitat in the northeastern GOMx is

789   needed.

790

791   **4.3 | Conservation status**

792   The small population size and associated deleterious genetic effects (e.g., inbreeding depression,

793   loss of potentially adaptive genetic diversity and accumulation of deleterious mutations), and the

794   restricted distribution alone, place these whales at high risk of extinction and they are of grave

795   conservation concern. They recently have been listed as Endangered under the U.S. Endangered

796   Species Act of 1973 and are listed as a Critically Endangered subpopulation on the IUCN Red

797   List (Corkeron et al., 2017). Additional significant threats include vessel collisions,

798   anthropogenic noise during seismic surveys, habitat destruction, modification or curtailment of

799   habitat range during energy exploration and development, oil spills and oil spill response, and

800   marine debris (Rosel et al., 2016). Fishery interactions may also pose a threat, but more research

801   is necessary to determine the level of impact from this threat (Rosel et al., 2016; Soldevilla et al.,

802   2017). The recent analyses of dive behaviors by Soldevilla et al. (2017) indicate these whales

803   may feed near the seafloor in a region where some bottom longline fishing occurs, raising the

804   risk of fishery interactions. The surface behavior identified by the same study suggests these

805   whales may spend a considerable amount of time at night within the first 15 m of the water

806   column. This behavior significantly raises the risk of ship strikes. Two whales have shown

807   evidence for ship strike. An adult, lactating female stranded in Tampa Bay, Florida with injuries,

808   including separated vertebral, lung damage, and subdermal contusions, consistent with impact

809   caused by a large object. In 2019, a free-swimming whale was observed in the northeastern

810   GOMx with a severely deformed spine posterior to the dorsal fin consistent with a vessel strike

811   (Fig. 6). These two cases illustrate the anthropogenic threat that vessels may pose to this

812   population. Finally, the 2019 whale that stranded in the Everglades (FMMSN1908, USNM

813   594665) was found to have a sharp piece of intragastric plastic approximately 6.6l x 6.2w x 0.2d

814   cm in dimension. The plastic caused hemorrhaging and acute gastric necrosis in the second

815   stomach chamber. The whale was thin and because the necropsy identified no other infections or

816   pathologies that could be attributed to the animal's death, it was concluded that the ingestion of

817   the plastic led to the stranding and subsequent mortality of this whale.

818

819   Continued efforts to fully characterize dive behavior, feeding strategies, and prey preference will

820   improve management strategies for this Endangered whale. In addition, ongoing research to

821   determine whether they regularly use habitat in the western and/or southern GOMx will aid our

822   understanding of their distribution. If they are shown to use these waters with regularity, further

823   work to determine the relationship of such whales to those utilizing the northeastern GOMx is

824   critical to developing a full picture of the status and range of these whales. Finally, a better

825   understanding of whether they once were a component of the ecosystem in the north-central and

826   western GOMx, as suggested by Reeves et al. (2011) based on Yankee whaling records, prior to

827   the extensive alteration of habitat through energy exploration and development is needed. If they

828   previously utilized habitat in the western GOMx, understanding why they may have abandoned

829   the habitat will significantly aid conservation and recovery plans for these whales.

830

4.4 | Conclusion

831

832   The data presented here provide multiple lines of evidence (genetics, morphology, distribution)

833   indicating that the Bryde's-like whales in the GOMx are a previously unnamed species. The

834   morphological and genetic lines of evidence that distinguish these whales in the GOMx as a new

835   species also provide equivalent support for re-elevating the two subspecies of *B. edeni* to species

836   level, *B. edeni* Anderson, 1879 and *B. brydei* Olsen, 1913. Here, the only species that would

837   then utilize the English name Bryde's whale would be *B. brydei*, the larger, more pelagic

838   balaenopterid distributed world-wide in tropical and subtropical oceans. Eden's whale would

839   refer to *B. edeni*, the smaller animals found, to date, in coastal and shelf waters of the tropical

840   and subtropical Indian and western Pacific Oceans. The terms "Bryde's-like whale" and

841   "Bryde's whale complex" would not be necessary any more. Future investigation of other

842   coastal populations, such as the population off the coast of south Africa (Best, 1977; Best, 2001;

843   Penry et al., 2018) may continue to identify new subspecies.

844

845   We recognize the lingering unfinished, but ongoing, taxonomic work in this group, i.e.,

846   genetically verifying the holotype of *B. edeni* and the need to identify and designate a neotype

847   specimen and its associated genetic signature for *B. brydei*. Some may not yet support species

848   rank for these lineages, but might rather support continued recognition of subspecies status until

849   these underlying taxonomic details are worked out. However, a convincing volume of evidence,

850   both morphological and genetic, has grown substantially in recent years (Kershaw et al., 2013;

851   Penry et al., 2018; Rosel & Wilcox, 2014; Sasaki et al., 2006; Wada et al., 2003; Yamada et al.,

852   2006; Yamada et al., 2008) and multiple independent lines of evidence are consistent with

853 species level differences for all members of the "Bryde's whale complex" and now for the new

854 evolutionarily distinct species found in the GOMx.

855

856 **4.5 | Systematics**

857

858 Order Cetartiodactyla Montgelard, Catzefils and Douzery, 1997

859 Cetacea Brisson, 1762

860 Family Balaenopteridae Gray, 1864

861 Genus *Balaenoptera* Lacépède, 1804

862 *Balaenoptera ricei* sp. nov.

863 Rice's whale

864 Figs. 3, 7, 8; Table 1; Figs. S8 – S10

865

866

867 *Holotype and Type Locality*

868 594665, an adult male, 1,126 cm, stranded on 29 January 2019 near

869

870 The skull (Figs. 7, S10) and complete skeleton and baleen are deposited in the

871 The full mtDNA control region sequence for the holotype

872 has been placed in GenBank with accession number MN017985.

873

874 *Additional Material*

875   Lowery (1974) reported a skull found on the Chandeleur Islands, St. Bernard Parish, Louisiana

876   in June 1954. This specimen is housed in the Louisiana State University Museum of Natural

877   Science (LSUMZ 17027) and was originally identified as a fin whale. We sequenced the

878   mitochondrial DNA control region of this specimen and identified it as a Rice's whale.

879   Unfortunately, the skull is missing a number of important bones, including the premaxillae,

880   nasals, lacrimals, jugals, and pterygoid hamuli. Photographs of the skull are in Lowery (1974)

881   and Figs. S3, S4.

882

883   A complete skull and skeleton of a 1,105 cm immature male whale that stranded in New

884   Hanover County, North Carolina (34.07° -77.88°) on March 13, 2003 was deposited in the

885   The whale was

886   genetically confirmed to be a Rice's whale (Rosel & Wilcox, 2014). Best (2007) published

887   photographs of the skull of this specimen and assigned it as *B. edeni*. Photographs of the skull

888   are also in Fig. S5.

889

890   On 4 October 2009, a 1,265 cm adult female whale stranded in Tampa Bay, Florida (27.91° -

891   82.43°) and the carcass was buried in Fort De Soto Park, Pinellas County, Florida. The whale

892   was genetically confirmed as a Rice's whale (Rosel & Wilcox, 2014). In March 2018, the

893   remains were excavated in the hopes of finding an intact skull to serve as a type specimen.

894   Unfortunately, the skull had been crushed during burial and most of the specimen lay in water

895   for the nine years it was buried. The remains of the skull and a nearly complete vertebral column

896   were retrieved and deposited in the Florida Museum of Natural History in Gainesville, Florida

897   with accession number UF33536.

898

Diagnosis

Balaenoptera ricei differs from *B. e. edeni* and *B. e. brydei* in the following morphological

features: the nasals taper and curve laterally at the posterior end and have a smooth margin,

meeting the medial-posterior margin of the ascending process of the maxilla; there is a broad gap

between the nasal bones that does not narrow posteriorly created in part by the frontal bones

which protrude anteriorly between the posterior end of the nasals (Fig. 8). Rice's whale can also

be differentiated from all other species of rorqual baleen whales based on molecular genetic

characters, as shown in the phylogenic analyses of the mtDNA control region (Table 3, Fig. 2).

Within the 305 base pair alignment of the 5' end of the mtDNA control region, ten diagnostic

sites differentiate *B. ricei* from both *B. e. brydei* and *B. e. edeni* (Table 2).

909

Description

The Rice's whale is a medium-sized rorqual whale. They appear to be larger than Omura's

whales and smaller than Bryde's whales, *B. e. brydei*, but, based on limited samples, about the

same size as Eden's whales. To date, the largest verified Rice's whale was 1,265 cm in length (a

lactating female) and the largest male was 1,126 cm. Rice's whales have a falcate dorsal fin

(Fig. S6). In the holotype specimen, the dorsal fin was located approximately 2/3 of the way

back from the snout. The flippers are uniformly dark. Although sample sizes are small, the

ventral grooves/pleats reach to or just past the umbilicus; in the holotype specimen 1 pleat

extended 36 cm past the umbilicus and two additional pleats extended past the umbilicus but

were not measured (Table S4). The number of pleats counted on the holotype specimen at the

920   flipper insertion was 27 to the central midline making a total of 54 pleats. These whales exhibit

921   no external asymmetrical pigmentation on the lower jaws, thereby differentiating them from the

922   asymmetrical jaw coloration seen in fin whales and Omura's whales. Body color is uniformly

923   dark charcoal gray above, including both the upper and lower jaws, and light to pinkish

924   countershading ventrally. Some whales exhibit diffuse white washes on the body around the

925   base of the dorsal fin and/or along the sides but to date no consistency in the pattern across

926   individuals has been seen (Fig. S7). The fringe of the baleen plates is uniformly cream colored

927   throughout the entire rack, the anterior baleen plates are cream colored on both sides, with a

928   distinct posterior transition to black plates (Fig. 3). Plate count for the holotype specimen was

929   264 on the left side. A total of 224 plates were counted on the right side but approximately 60

930   cm of the baleen rack of the right side was not accessible making this is an incomplete count.

931   Mead (1977) and Kato and Perrin (2018) indicated that the baleen bristles of members of the

932   Bryde's whale complex are coarser than those of sei whales, and we can confirm, based on a

933   sample size of three, that the baleen bristles of Rice's whales from the GOMx are coarser than

934   that of a sei whale that stranded in the GOMx in 1994. However, no comprehensive analysis of

935   bristle diameter across all the Bryde's whale taxa has yet been performed.

936

937   The vertebral formula of the holotype is cervical (7) + thoracic (13) + lumbar (13) + caudal (20)

938   = 53. There were 13 ribs on either side and the head of each first rib is bifurcated.

939

940   Several other unique features were noted in the skeleton of the holotype. Junge (1950),

941   Lönnberg (1931), and Omura (1959) describe the stylohyal bones of Bryde's whales as generally

942   longer than they are wide with some degree of curvature. The stylohyal bones of the holotype of

943   *B. ricei* had little curvature to them and are very broad (Fig. S9). In addition, the pelvic bones of

944   the holotype specimen are nearly straight, with only a very small projection on one side (Fig.

945   S9).

946

947   *Etymology*

948   The specific name, *ricei*, is in honor of renowned American cetologist Dale W. Rice (1930-

949   2017). We choose this species name to commemorate Dale W. Rice who had a distinguished 60-

950   year career in marine mammal science and wrote the seminal volume "Marine Mammals of the

951   World" (Rice, 1998), which provided the first comprehensive worldwide review of the

952   systematics and distribution of all marine mammal species. He was the first researcher to

953   recognize that Bryde's whales are present in the GOMx (Rice, 1965). We propose Rice's whale

954   as the common English name. Naming it after a person is consistent with the other members of

955   the complex: Eden's whale (*B. e. edeni*) having been named after Ashley Eden, a British

956   Commissioner (Anderson, 1878 [1879]), Bryde's whale (*B. e. brydei*) named after Johan Bryde,

957   a Norwegian businessman and whaler (Olsen, 1913), and Omura's whale (*B. omurai*) was named

958   after the Japanese cetologist Hideo Omura (Wada et al., 2003). We note that the common name

959   'Gulf of Mexico whale' has been used for this species.

960

961   *Nomenclatural Statement*

962   A Life Science Identifier (LSID) was obtained for this publication:

963

964

965   *Comparison*

966   Externally, Rice's whale is separated from all other balaenopterid whales except those in the

967   Bryde's whale complex by the presence of three longitudinal ridges on the rostrum; one in the

968   center and two lateral ridges (Fig. 1). Omura's whale lacks these prominent lateral ridges,

969   instead having faint ridges visible only in certain viewing conditions (Cerchio et al., 2015).

970

971   As described in Wada et al. (2003), the vertex of the skull, including the shapes and extent of the

972   ascending process of the maxilla (APM), the nasals, frontals, premaxillae serve as much of the

973   defining morphological characteristics that separate members of the Bryde's whale complex

974   (Fig. 8). In this region, *B. ricei* is clearly differentiated from *B. e. edeni* by the shape and extent

975   of the ascending process of the maxilla which broaden only slightly at the posterior end, more

976   similar in shape to *B. e. brydei* than *B. omurai* or *B. e. edeni*, with *B. e. edeni* being distinctive in

977   its slender ascending process of the maxilla with rounded posterior end (Fig. 8, S10). *B. ricei*

978   also differs from *B. e. edeni* in the shape of the nasals (triangular versus rectangular), and the

979   extent of the frontals, which are exposed as a thin strip or belt between the ascending processes

980   of the maxilla, the posterior end of the nasals and the supraoccipital, rather than the broad

981   exposure of the frontals seen in *B. e. edeni*. *B. ricei* is most easily differentiated from *B. omurai*

982   by the posterior end of the premaxillae which reach the frontals in *B. ricei* but not in *B. omurai*

983   (Fig. 8). In addition, the alisphenoid is in contact with the squamosal (Fig. S8) while it is

984   separated from the squamosal bone in *B. omurai* (Wada et al., 2003). Finally, *B. ricei* can be

985   distinguished from *B. e. brydei* by the shape of the posterior end of the nasals which curve

986   laterally and have smooth margins, while in *B. e. brydei* the posterior end of the nasals remains

987   relatively straight and the posterior margin is crenulated. In addition, the frontal bones wrap

988   around and extend anteriorly into the space between the posterior end of the nasals, creating a

989   significant space or gap between the nasal bones along their entire length.

990

991   Finally, *B. ricei* is unambiguously discriminated from all other balaenopterid whales by DNA

992   sequence of the mitochondrial genome. Ten diagnostic sites in the 5' end of the mitochondrial

993   control region (between nucleotide positions 15536-15818 of the *B. e. brydei* mtDNA genome

994   GenBank accession number AB201259) separate *B. ricei* from all members of the Bryde's whale

995   complex (Table 2). Similarly, mitochondrial cytochrome *b* and cytochrome oxidase I genes

996   exhibit multiple fixed differences between *B. ricei* and *B. e. edeni*, *B. e. brydei*, and *B. omurai*

997   (Rosel & Wilcox, 2014).

998

999   *Distribution*

1000   Based on vessel and aerial survey sightings, the primary core habitat of Rice's whale is currently

1001   in the northeastern GOMx, centered over the De Soto Canyon in waters between 150 and 410 m

1002   depth (Fig. 4). Recently there was a genetically confirmed sighting in the western GOMx off the

1003   central Texas coast in 225 m water depth (National Marine Fisheries Service, 2018), and

1004   preliminary analysis of acoustic recordings from the western GOMx along the shelf break south

1005   of the Flower Garden Banks National Marine Sanctuary suggest the presence of Bryde's-like

1006   whales[6] in the same area as two balaenopterid sightings made by NMFS in the early 1990s (Fig.

1007   4). While contemporary sightings are primarily confined to the northeastern GOMx, it is

1008   possible the species historically had a broader distribution in the GOMx. Reeves et al. (2011)

---

[6] M Soldevilla, pers comm. National Marine Fisheries Service 75 Virginia Beach Drive, Miami Fl, 33149. April 2019

1009   reviewed whaling logbooks from the GOMx and identified records of "finback" whales from the

1010   north central Gulf south of the Mississippi River delta and in the southern Gulf on the Campeche

1011   Banks. As fin whales are not part of the GOMx ecosystem, these were likely Rice's whales

1012   misidentified as fin whales (Reeves et al., 2011), suggesting the whale's distribution was broader

1013   than we see today.

1014

1015

1062   or opinions expressed herein, are those of the author(s) and do not necessarily reflect those of

1063   NOAA or the Department of Commerce.

1064

1065   REFERENCES

1066

1067   Alves, F., Dinis, A., Cascão, I., & Freitas, L. (2010). Bryde's whale (*Balaenoptera brydei*) stable

1068   associations and dive profiles: New insights into foraging behavior. *Marine Mammal*

1069   *Science*, *26*, 202-212.

1070   Amos, B., Schlötterer, C., & Tautz, D. (1993). Social structure of pilot whales revealed by

1071   analytical DNA profiling. *Science*, *260*, 670-672.

1072   Anderson, J. (1878 [1879]). *Anatomical and zoological researches: Comprising an account of*

1073   *the zoological results of the two expeditions to western Yunnan in 1868 and 1875 and a*

1074   *monograph of the two cetacean genera, Platanista and Orcella*. Bernard Quaritch.

1075   Archer, F. I., Martien, K. K., & Taylor, B. L. (2017). Diagnosability of mtDNA with Random

1076   Forests: Using sequence data to delimit subspecies. *Marine Mammal Science*, *33(Special*

1077   *Issue)*, 101-131.

1078   Archer, F. I., Morin, P. A., Hancock-Hanser, B. L., Robertson, K. M., Leslie, M. S., Bérube´, M.,

1079   Panigada, S., & Taylor, B. L. (2013). Mitogenomic phylogenetics of fin whales

1080   (*Balaenoptera physalus* spp.): Genetic evidence for revision of subspecies. *PLoS ONE*, *8*,

1081   e63396.

1082   Bérubé, M., Rew, M., Skaug, H., Jørgensen, H., Robbins, J., Best, P., Sears, R., & Palsbøll, P.

1083   (2005). Polymorphic microsatellite loci isolated from humpback whale, *Megaptera*

1084   *novaeangliae* and fin whale, *Balaenoptera physalus*. *Conservation Genetics*, *6*, 631-636.

1085   Best, P. B. (1977). Two allopatric forms of Bryde's whale off South Africa. *Report of the*

1086   *International Whaling Commission*, *1*, 10-38.

1087   Best, P. B. (2001). Distribution and population separation of Bryde's whale *Balaenoptera edeni*

1088   off southern Africa. *Marine Ecology Progress Series*, *220*, 277-289.

1089   Best, P. B. (2007). *Whales and dolphins of the southern African subregion*. Cambridge

1090   University Press.

1091   Brownstein, M. J., Carpten, J. D., & Smith, J. R. (1996). Modulation of non-templated nucleotide

1092   addition by *Taq* DNA polymerase: Primer modifications that facilitate genotyping.

1093   *Biotechniques*, *20*, 1004-1010.

1094   Carroll, E. L., Gallego, R., Sewell, M. A., Zeldis, J., Ranjard, L., Ross, H. A., Tooman, L. K.,

1095   O'Rorke, R., Newcomb, R. D., & Constantine, R. (2019). Multi-locus DNA metabarcoding

1096   of zooplankton communities and scat reveal trophic interactions of a generalist predator.

1097   *Scientific Reports*, *9*, 281.

1098   Cerchio, S., Andrianantenaina, B., Lindsay, A., Rekdahl, M., Andrianarivelo, N., &

1099   Rasoloarijao, T. (2015). Omura's whales (*Balaenoptera omurai*) off northwest Madagascar:

1100   Ecology, behaviour and conservation needs. *Royal Society Open Science*, *2*, 150301.

1101   Cerchio, S., Yamada, T. K., & Brownell, R. L. (2019). Global distribution of Omura's whales

1102   (*Balaenoptera omurai*) and assessment of range-wide threats. *Frontiers in Marine Science*, *6*,

1103   67.

1104   Committee on Taxonomy. (2019). *List of marine mammal species and subspecies*. Society for

1105   Marine Mammalogy, www.marinemammalscience.org, consulted on 26 April 2019

1106   Corkeron, P., Reeves, R., & Rosel, P. (2017). *Balaenoptera edeni* Gulf of Mexico subpopulation.

1107   *The IUCN Red List of Threatened Species 2017*, *e.T117636167A117636174*.

1108   Currie, D., Wunderle Jr, J. M., Freid, E., Ewert, D. N., & Lodge, D. J. (2019). *The natural*

1109   *history of the Bahamas: A field guide*. Comstock Publishing Associates an imprint of Cornell

1110   University Press.

1111   Cypriano-Souza, A. L., de Meirelles, A. C. O., Carvalho, V. L., & Bonatto, S. L. (2017). Rare or

1112   cryptic? The first report of an Omura's whale (*Balaenoptera omurai*) in the South Atlantic

1113   Ocean. *Marine Mammal Science*, *33*, 80-95.

1114   Davis, J. I., & Nixon, K. C. (1992). Populations, genetic variation, and the delimitation of

1115   phylogenetic species. *Systematic Biology*, *41*, 421-435.

1116   de Boer, M. N. (2015). Cetaceans observed in Suriname and adjacent waters. *Latin American*

1117   *Journal of Aquatic Mammals*, *10*, 2-19.

1118   de Moura, J. F., & Siciliano, S. (2012). Stranding pattern of Bryde's whales along the south-

1119   eastern coast of Brazil. *Marine Biodiversity Records*, *5*, e73.

1120   Debich, A., Baumann-Pickering, S., Širović, A., Buccowich, J., Gentes, Z., Gottlieb, R.,

1121   Johnson, S., Kerosky, S., Roche, L., Thayre, B., Trickey, J., Wiggins, S., Hildebrand, J.,

1122   Hodge, L., & Read, A. (2014). *Passive acoustic monitoring for marine mammals in the*

1123   *Cherry Point OPAREA 2011-2012. Final Report. Submitted to Naval Facilities Engineering*

1124   *Command (NAVFAC) Atlantic, Norfolk, Virginia, under Contract No. N62470-10D-3011*

1125   *issued to HDR, Inc*.

1126   Debrot, A. O. (1998). New cetacean records for Curacao, Netherlands Antilles. *Caribbean*

1127   *Journal of Science*, *34*, 168-170.

1128   Debrot, A. O., De Meyer, J. A., & Dezentjé, P. J. E. (1998). Additional records and a review of

1129   the cetacean fauna of the Leeward Dutch Antilles. *Caribbean Journal of Science*, *34*, 204-

1130   210.

1131   Debrot, A. O., Esteban, N., Bervoets, T., Hoetjes, P. C., & Scheidat, M. (2013). Marine

1132   mammals of the northeastern Caribbean Windward Dutch Islands: Saba, St. Eustatius, St.

1133   Maarten, and the Saba Bank. *Caribbean Journal of Science*, *47*, 159-172.

1134   Edds, P. L., Odell, D. K., & Tershy, B. R. (1993). Vocalizations of a captive juvenile and free-

1135   ranging adult-calf pairs of Bryde's whales, *Balaenoptera edeni*. *Marine Mammal Science*, *9*,

1136   269-284.

1137   Excoffier, L., & Lischer, H. E. L. (2010). Arlequin suite ver 3.5: A new series of programs to

1138   perform population genetics analyses under Linux and Windows. *Molecular Ecology*

1139   *Resources*, *10*, 564-567.

1140   Frasier, K., Debich, A., Hildebrand, J., Rice, A., Brewer, A., Herbert, S., Thayre, B., Wiggins,

1141   S., Baumann-Pickering, S., Širović, A., Hodge, L., & Read, A. (2016). *Passive acoustic*

1142   *monitoring for marine mammals in the Jacksonville Range Complex August 2014 – May*

1143   *2015. Final Report. Marine Physical Laboratory Technical Memorandum 601. March 2015.*

1144   *Submitted to Naval Facilities Engineering Command (NAVFAC) Atlantic, Norfolk, Virginia,*

1145   *under Contract No. N62470-15-D-8006 Subcontract #383-8476 (MSA2015-1176 Task Order*

1146   *003) issued to HDR, Inc.*

1147   Gonçalves, L. R., Augustowski, M., & Andriolo, A. (2016). Occurrence, distribution and

1148   behaviour of Bryde's whales (Cetacea: Mysticeti) off south-east Brazil. *Journal of the Marine*

1149   *Biological Association of the United Kingdom*, *96*, 943-954.

1150   Gunter, G., & Overstreet, R. (1974). Cetacean notes. I. Sei and rorqual whales on the Mississippi

1151   coast, A correction. II. A dwarf sperm whale in Mississippi Sound and its helminth parasites.

1152   *Gulf Research Reports*, *4*, 479-481.

1153   Harris, A., & Richard, D. (1987). Caught between the devil and the deep blue sea. *Louisiana*

1154   *Conservationist*, *January/February*, 4-9.

1155   Hazevoet, C. J., Monteiro, V., López, P., Varo, N., Torda, G., Berrow, S., & Gravanita, B.

1156   (2010). Recent data on whales and dolphins (Mammalia: Cetacea) from the Cape Verde

1157   Islands, including records of four taxa new to the archipelago. *Zoologia Caboverdiana*, *1*, 75-

1158   99.

1159   Hazevoet, C. J., & Wenzel, F. W. (2000). Whales and dolphins (Mammalia, Cetacea) of the Cape

1160   Verde Islands, with special reference to the humpback whale *Megaptera novaeangliae*

1161   (Borowski, 1781). *Contributions to Zoology*, *69*, 197-211.

1162   Herath, D. R. (2007). Identification of a stranded whale by mitochondrial DNA analysis -

1163   www.DNA-Surveillance program in action. *Asian Fisheries Science*, *20*, 319-324.

1164   Huelsenbeck, J. P., & Rannala, B. (2004). Frequentist properties of Bayesian posterior

1165   probabilities of phylogenetic trees under simple and complex substitution models. *Systematic*

1166   *Biology*, *53*, 904-913.

1167   Huelsenbeck, J. P., & Ronquist, F. (2001). MRBAYES: Bayesian inference of phylogenetic

1168   trees. *Bioinformatics*, *17*, 754-755.

1169   IUCN. (2012). *IUCN Red List Categories and Criteria: Version 3.1* (2nd ed.). International

1170   Union for Conservation of Nature and Natural Resources.

1171   Jayasankar, P., Anoop, B., Rajagopalan, M., Yousuf, K. M. M., Reynold, P., Krishnakumar, P.

1172   K., Afsal, V. V., & Krishnan, A. A. (2009). Indian efforts on the inventorization of marine

1173   mammal species for their conservation and management. *Asian Fisheries Science*, *22*, 143-

1174   155.

1175   Jefferson, T. A. (1995). *Distribution, abundance and some aspects of the biology of cetaceans in*

1176   *the offshore Gulf of Mexico* [Ph.D. dissertation, Texas A & M University]. College Station,

1177   TX.

1178   Jefferson, T. A., & Schiro, A. J. (1997). Distribution of cetaceans in the offshore Gulf of Mexico.

1179   *Mammal Review*, *27*, 27-50.

1180   Jung, J.-L., Mullié, W. C., Van Waerebeek, K., Wagne, M. M., Ould Bilal, A. S., Ould Sidaty, Z.

1181   E. A., Toomey, L., Méheust, E., & Marret, F. (2016). Omura's whale off West Africa:

1182   Autochthonous population or inter-oceanic vagrant in the Atlantic Ocean? *Marine Biology*

1183   *Research*, *12*, 66-75.

1184   Junge, G. C. A. (1950). On a specimen of the rare fin whale, *Balaenoptera edeni* Anderson,

1185   stranded on Pulu Sugi near Singapore. *Zoologische Verhandelingen*, *9*, 1-26.

1186   Kanda, N., Goto, M., Kato, H., McPhee, M. V., & Pastene, L. A. (2007). Population genetic

1187   structure of Bryde's whales (*Balaenoptera brydei*) at the inter-oceanic and trans-equatorial

1188   levels. *Conservation Genetics*, *8*, 853-864.

1189   Kato, H., & Perrin, W. F. (2018). Bryde's Whale *Balaenoptera edeni*. In B. Würsig, J. G. M.

1190   Thewissen, & K. M. Kovacs (Eds.), *Encyclopedia of Marine Mammals* (3rd Edition ed., pp.

1191   143-145). Academic Press/Elsevier.

1192   Kershaw, F., Leslie, M. S., Collins, T., Mansur, R. M., D, S. B., Minton, G., Baldwin, R., LeDuc,

1193   R. G., Anderson, R. C., Brownell, J., R L, & Rosenbaum, H. C. (2013). Population

1194   differentiation of 2 forms of Bryde's whales in the Indian and Pacific Oceans. *Journal of*

1195   *Heredity*, *6*, 755–764.

1196   Kim, J. H., Kim, H. W., Kim, E. M., & Sohn, H. (2018). First record of the Omura's whale

1197   (*Balaenoptera omurai*) in Korean waters. *Animal Systematics, Evolution and Diversity*, *34*,

1198   162-167.

1199   Konishi, K., Tamura, T., Isoda, T., Okamoto, R., Hakamada, T., Kiwada, H., & Matsuoka, K.

1200   (2009). Feeding strategies and prey consumption of three baleen whale species within the

1201   Kuroshio-Current extension. *Journal of Northwest Atlantic Fishery Science*, *42*, 27-40.

1202   Kumar, S., Stecher, G., Li, M., Knyaz, C., & Tamura, K. (2018). MEGA X: Molecular

1203   Evolutionary Genetics Analysis across computing platforms. *Molecular Biology and*

1204   *Evolution*, *35*, 1547-1549.

1205   LaBrecque, E., Curtice, C., Harrison, J., Van Parijs, S. M., & Halpin, P. N. (2015). 3.

1206   Biologically important areas for cetaceans within U.S. waters – Gulf of Mexico region.

1207   *Aquatic Mammals*, *41*, 30-38.

1208   Leduc, R., Robertson, K., & Pitman, R. (2008). Mitochondrial sequence divergence among

1209   Antarctic killer whale ecotypes is consistent with multiple species. *Biology Letters*, *4*, 426-

1210   429.

1211   Li, T., Wu, H., Wu, C., Yang, G., & Chen, B. (2019). Molecular identification of stranded

1212   cetaceans in coastal China. *Aquatic Mammals*, *45*, 525-532.

1213   Lodi, L., Tardin, R. H., Hetzel, B., Maciel, I. S., Figueiredo, L. D., & Simão, S. M. (2015).

1214   Bryde's whale (Cetartiodactyla: Balaenopteridae) occurrence and movements in coastal areas

1215   of southeastern Brazil. *Zoologia (Curitiba)*, *32*, 171-175.

1216   Lönnberg, E. (1931). The skeleton of *Balaenoptera brydei* Ö. Olsen. *Arkiv för Zoologi*, *23A1*, 1–

1217   23.

1218   Lowenstein, J. H., Amato, G., & Kolokotronis, S.-O. (2009). The real *maccoyii*: Identifying tuna

1219   sushi with DNA barcodes – Contrasting characteristic attributes and genetic distances. *PLoS*

1220   *ONE*, *4*, e7866.

1221   Lowery, G. H., Jr. (1974). *Mammals of Louisiana and its adjacent waters*. Louisiana State

1222   University Press.

1223   Luksenburg, J. A., Henriquez, A., & Sangster, G. (2015). Molecular and morphological evidence

1224   for the subspecific identity of Bryde's whales in the southern Caribbean. *Marine Mammal*

1225   *Science*, *31*, 1568-1579.

1226   Maciel, I., Tardin, R., & Simão, S. (2018). Occurrence and habitat use of Bryde's whales

1227   (*Balaenoptera edeni*) in the Cabo Frio region, South-eastern Brazil. *Journal of the Marine*

1228   *Biological Association of the United Kingdom*, *98*, 1081-1086.

1229   Mead, J. G. (1977). Records of sei and Bryde's whales from the Atlantic coast of the United

1230   States, the Gulf of Mexico, and the Caribbean. *International Whaling Commission*, *Special*

1231   *Issue 1*, 113-116.

1232   Mignucci-Giannoni, A. A., Pinto-Rodríguez, B., Velasco-Escudero, M., Montoya-Ospina, R. A.,

1233   Jiménez, N. M., Rodríguez-López, M. A., Williams, J. E. H., & Odell, D. K. (1999).

1234   Cetacean strandings in Puerto Rico and the Virgin Islands. *Journal of Cetacean Research*

1235   *and Management*, *1*, 191-198.

1236   Murakami, C., Yoshida, H., & Yonezaki, S. (2018). Cookie-cutter shark *Isistius brasiliensis* eats

1237   Bryde's whale *Balaenoptera brydei*. *Ichthyological Research*, *65*, 398-404.

1238   Murase, H., Tamura, T., Kiwada, H., Fujise, Y., Watanabe, H., Ohizumi, H., Yonezaki, S.,

1239   Okamura, H., & Kawahara, S. (2007). Prey selection of common minke (*Balaenoptera*

1240   *acutorostrata*) and Bryde's (*Balaenoptera edeni*) whales in the western North Pacific in 2000

1241   and 2001. *Fisheries Oceanography*, *16*, 186-201.

1242   National Marine Fisheries Service. (2018). *Cruise Report NOAA Ship Gordon Gunter Cruise*

1243   *GU17-03 July - August 2017, GoMMAPPS Summer 2017 Research Cruise* (NOAA, National

1244   Marine Fisheries Service, Southeast Fisheries Science Center). U.S. Department of

1245   Commerce.

1246   Nei, M. (1987). *Molecular evolutionary genetics*. Columbia University Press.

1247   Olsen, Ö. (1913). On the external characters and biology of Bryde's whale (*Balaenoptera*

1248   *brydei*), a new rorqual from the coast of South Africa. *Proceedings of the Zoological Society*

1249   *of London*, *1913*, 1073-1090.

1250   Omura, H. (1959). Bryde's whales from the coast of Japan. *Scientific Reports of the Whales*

1251   *Research Institute Tokyo*, *14*, 1-33.

1252   Palsbøll, P., Bérubé, M., Larsen, A., & Jørgensen, H. (1997). Primers for the amplification of tri-

1253   and tetramer microsatellite loci in baleen whales. *Molecular Ecology*, *6*, 893-895.

1254   Park, S. D. E. (2001). *Trypanotolerance in West African cattle and the population genetic effects*

1255   *of selection* [Ph.D. dissertation, University of Dublin]. Dublin, Ireland.

1256   Pastene, L. A., Acevedo, J., Siciliano, S., Sholl, T. G., de Moura, J. F., Ott, P. H., & Aguayo-

1257   Lobo, A. (2015). Population genetic structure of the South American Bryde's whale. *Revista*

1258   *de Biología Marina y Oceanografía*, *550*, 453-464.

1259   Peakall, R., & Smouse, P. E. (2006). GENALEX 6: Genetic analysis in Excel. Population genetic

1260   software for teaching and research. *Molecular Ecology Notes*, *6*, 288-295.

1261   Penry, G. S. (2010). *The biology of South African Bryde's whales* [Ph.D. dissertation, University

1262   of St. Andrews]. St. Andrews, Scotland.

Penry, G. S., Hammond, P. S., Cockcroft, V. G., Best, P. B., Thornton, M., & Graves, J. A.

    (2018). Phylogenetic relationships in southern African Bryde's whales inferred from

    mitochondrial DNA: further support for subspecies delineation between the two allopatric

    populations. *Conservation Genetics*, *19*, 1349-1365.

Perrin, W. F., Rosel, P. E., & Cipriano, F. (2013). How to contend with paraphyly in the

    taxonomy of the delphinine cetaceans? *Marine Mammal Science*, *29*, 567–588.

Posada, D. (2008). jModelTest: Phylogenetic model averaging. *Molecular Biology and*

    Evolution, *25*, 1253-1256.

Rafter, M. A., Frasier, K. E., Trickey, J. S., Hildebrand, J. A., Rice, A. C., Thayre, B. J.,

    M.Wiggins, S., Širovic, A., & Baumann-Pickering, S. (2018). *Passive acoustic monitoring*

    for marine mammals at Norfolk Canyon April 2016 – June 2017. Final Report. Marine

    Physical Laboratory Technical Memorandum 629. Submitted to Naval Facilities Engineering

    Command (NAVFAC) Atlantic, Norfolk, Virginia, under Contract No. N62470-15-D-8006

    Subcontract #383-8476 (MSA2015-1176 Task Order 003) issued to HDR, Inc.

Rambaut, A., & Drummond, A. (2007). *Tracer v1.4. Available from*

    http://beast.bio.ed.ac.uk/Tracer

Reeves, R. R., Lund, J. N., Smith, T. D., & Josephson, E. A. (2011). Insights from whaling

    logbooks on whales, dolphins, and whaling in the Gulf of Mexico. *Gulf of Mexico Science*,

    29, 41-67.

Reeves, R. R., Perrin, W. F., Taylor, B. L., Baker, C. S., & Mesnick, S. L. (2004). *Report of the*

    workshop on shortcomings of cetacean taxonomy in relation to needs of conservation and

    management, April 30- May 2, 2004 La Jolla, California (NOAA Technical Memorandum

    NMFS-SWFSC-363). U.S. Department of Commerce.

1286 Rice, A., Palmer, K., Muirhead, C., Tielens, J., & Clark, C. (2014). Potential Bryde's whale

1287   (*Balaenoptera edeni*) calls recorded in the northern Gulf of Mexico. *Journal of the*

1288   *Acoustical Society of America*, *135*, 3066-3076.

1289 Rice, D. W. (1965). Bryde's whale in the Gulf of Mexico. *Norsk Hvalfangst-Tidende*, *54*, 114-

1290   115.

1291 Rice, D. W. (1998). *Marine mammals of the world*. *Systematics and distribution* (Vol. Special

1292   Publication Number 4). The Society for Marine Mammalogy (Allen Press).

1293 Richard, K. R., Whitehead, H., & Wright, J. M. (1996). Polymorphic microsatellites from sperm

1294   whales and their use in the genetic identification of individuals from naturally sloughed

1295   pieces of skin. *Molecular Ecology*, *5*, 313-315.

1296 Roberts, J. J., Best, B. D., Mannocci, L., Fujioka, E., Halpin, P. N., Palka, D. L., Garrison, L. P.,

1297   Mullin, K. D., Cole, T. V. N., Khan, C. B., McLellan, W. A., Pabst, D. A., & Lockhart, G. G.

1298   (2016). Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico.

1299   *Scientific Reports*, *6*, 22615.

1300 Roden, C. L., & Mullin, K. D. (2000). Sightings of cetaceans in the northern Caribbean Sea and

1301   adjacent waters, winter 1995. *Caribbean Journal of Science*, *36*, 280-288.

1302 Romero, A., Agudo, A., Green, S., & di Sciara, G. (2001). *Cetaceans of Venezuela: Their*

1303   *distribution and conservation status*. (NOAA Technical Report NMFS 151). U.S.

1304   Department of Commerce.

1305 Rosel, P., & Wilcox, L. (2014). Genetic evidence reveals a unique lineage of Bryde's whales in

1306   the northern Gulf of Mexico. *Endangered Species Research*, *25*, 19-34.

1307 Rosel, P. E., & Block, B. A. (1996). Mitochondrial control region variability and global

1308   population structure in the swordfish, *Xiphias gladius*. *Marine Biology*, *125*, 11-22.

1309   Rosel, P. E., Corkeron, P. J., Engleby, L., Epperson, D., Mullin, K., Soldevilla, M. S., & Taylor,

1310   B. L. (2016). *Status review of Bryde's whales, (Balaenoptera edeni) in the Gulf of Mexico*

1311   *under the Endangered Species Act* (NOAA Technical Memorandum NMFS-SEFSC-692).

1312   U.S. Department of Commerce.

1313   Rosel, P. E., Hancock-Hanser, B. L., Archer, F. I., Robertson, K. M., Martien, K. K., Leslie, M.

1314   S., Berta, A., Cipriano, F., Viricel, A., Viaud-Martinez, K. A., & Taylor, B. L. (2017).

1315   Examining metrics and magnitudes of molecular genetic differentiation used to delimit

1316   cetacean subspecies based on mitochondrial DNA control region sequences. *Marine Mammal*

1317   *Science*, *33(Special Issue)*, 76-100.

1318   Rosel, P. E., Tiedemann, R., & Walton, M. (1999). Genetic evidence for limited trans-Atlantic

1319   movements of the harbor porpoise, *Phocoena phocoena*. *Marine Biology*, *133*, 583-591.

1320   Ross, S. W., Quattrini, A. M., Roa-Varón, A. Y., & McClain, J. P. (2010). Species composition

1321   and distributions of mesopelagic fishes over the slope of the north-central Gulf of Mexico.

1322   *Deep Sea Research Part II: Topical Studies in Oceanography*, *57*, 1926-1956.

1323   Sarkar, I. N., Thornton, J. W., Planet, P. J., Figurski, D. H., Schierwater, B., & DeSalle, R.

1324   (2002). An automated phylogenetic key for classifying homeoboxes. *Molecular*

1325   *Phylogenetics and Evolution*, *24*, 388-399.

1326   Sasaki, T., Nikaido, M., Wada, S., Yamada, T. K., Cao, Y., Hasegawa, M., & Okada, N. (2006).

1327   *Balaenoptera omurai* is a newly discovered baleen whale that represents an ancient

1328   evolutionary lineage. *Molecular Phylogenetics and Evolution*, *41*, 40-52.

1329   Shane, S., & Schmidly, D. (1976). Bryde's whale (*Balaenoptera edeni*) from the Louisiana coast.

1330   *Southwestern Naturalist*, *21*, 409-410.

1331   Siciliano, S., de Oliveira Santos, M. C., Vicente, A. F. C., Alvarenga, F. S., Zampirolli, É., Brito,

1332   J. L., Azevedo, A. F., & Pizzorno, J. L. A. (2004). Strandings and feeding records of Bryde's

1333   whales (*Balaenoptera edeni*) in south-eastern Brazil. *Journal of the Marine Biological*

1334   *Association of the United Kingdom*, *84*, 857-859.

1335   Širović, A., Bassett, H. R., Johnson, S. C., Wiggins, S. M., & Hildebrand, J. A. (2014). Bryde's

1336   whale calls recorded in the Gulf of Mexico. *Marine Mammal Science*, *30*, 399-409.

1337   Smultea, M. A., Holst, M., Koski, W. R., Roi, S. S., Sayegh, A. J., Fossati, C., Goldstein, H. H.,

1338   Beland, J. A., MacLean, S., & Yin, S. (2013). Visual-acoustic survey of cetaceans during a

1339   seismic study in the southeast Caribbean Sea, April—June 2004. *Caribbean Journal of*

1340   *Science*, *47*, 273-284.

1341   Soldevilla, M. S., Hildebrand, J. A., Frasier, K. E., Dias, L. A., Martinez, A., Mullin, K. D.,

1342   Rosel, P. E., & Garrison, L. P. (2017). Spatial distribution and dive behavior of Gulf of

1343   Mexico Bryde's whales: potential risk of vessel strikes and fisheries interactions.

1344   *Endangered Species Research*, *32*, 533-550.

1345   Soot-Ryen, T. (1961). On a Bryde's whale stranded on Curaçao. *Norsk Hvalfangst-Tidende*, *50*,

1346   323-332.

1347   Stecher, G., Tamura, K., & Kumar, S. (2020). Molecular Evolutionary Genetics Analysis

1348   (MEGA) for macOS. *Molecular Biology and Evolution*, *37*, 1237-1239.

1349   Steiner, L., Silva, M. A., Zereba, J., & Leal, M. J. (2008). Bryde's whales, *Balaenoptera edeni*,

1350   observed in the Azores: a new species record for the region. *Marine Biodiversity Records*, *1*,

1351   e66.

1352   Stickney, D. G., & Torres, J. J. (1989). Proximate composition and energy content of

1353   mesopelagic fishes from the eastern Gulf of Mexico. *Marine Biology*, *103*, 13-24.

1354   Swartz, S. L., & Burks, C. (2000). *Cruise results, Windwards humpback whale (Megaptera*

1355   *novaeangliae) survey, NOAA Ship Gordon Gunter Cruise GU-00-01, 9 February to 3 April*

1356   *2000* (NOAA-NMFS-SEFSC Technical Memorandum 438). U.S. Department of Commerce.

1357   Swartz, S. L., Martinez, A., Stamates, J., Burks, C., & Mignucci-Giannoni, A. (2002). *Acoustic*

1358   *and visual survey of cetaceans in the waters of Puerto Rico and the Virgin Islands: February*

1359   *– March 2011* (NOAA Technical Memorandum NMFS-SEFSC-463). U.S. Department of

1360   Commerce.

1361   Taylor, B. L., Archer, F. I., Martien, K. K., Rosel, P. E., Hancock-Hanser, B. L., Lang, A. R.,

1362   Leslie, M. S., Mesnick, S. L., Morin, P. A., Pease, V. L., Perrin, W. F., Robertson, K. M.,

1363   Parsons, K. M., Viricel, A., Vollmer, N. L., Reeves, R. R., Cipriano, F., Krützen, M., &

1364   Baker, C. S. (2017a). Guidelines and quantitative standards to improve consistency in

1365   cetacean subspecies and species delimitation relying on molecular genetic data. *Marine*

1366   *Mammal Science*, *33(Special Issue)*, 132-155.

1367   Taylor, B. L., Perrin, W. F., Reeves, R. R., Rosel, P. E., Wang, J. Y., Cipriano, F., Baker, C. S.,

1368   & R. L. Brownell, J. (2017b). Why we should develop guidelines and quantitative standards

1369   for using molecular genetic data to delimit subspecies for data-poor organisms like cetaceans

1370   *Marine Mammal Science*, *33(Special Issue)*, 12-26.

1371   Tershy, B. R. (1992). Body size, diet, habitat use, and social behavior of *Balaenoptera* whales in

1372   the Gulf of California. *Journal of Mammalogy*, *73*, 477-486.

1373   Valsecchi, E., & Amos, W. (1996). Microsatellite markers for the study of cetacean populations.

1374   *Molecular Ecology*, *5*, 151-156.

1375   Varona, L. (1965). *Balaenoptera borealis* Lesson (Mammalia: Cetacea) capturada en Cuba.

1376   *Poeyana Instituto de Biología*, *7A*, 1-4.

1377   Varona, L. (1973). *Catálogo de los mamíferos vivientes y extinguidos de las Antillas*. Academia

1378   de Ciencias de Cuba.

1379   Viricel, A., & Rosel, P. E. (2012). Evaluating the utility of *cox1* for cetacean species

1380   identification. *Marine Mammal Science*, *28*, 37-62.

1381   Vollmer, N. L., Viricel, A., Wilcox, L., Moore, M. K., & Rosel, P. E. (2011). The occurrence of

1382   mtDNA heteroplasmy in multiple cetacean species. *Current Genetics*, *57*, 115-131.

1383   Wada, S., Oishi, M., & Yamada, T. K. (2003). A newly discovered species of living baleen

1384   whale. *Nature*, *426*, 278-281.

1385   Waits, L. P., Luikart, G., & Taberlet, P. (2001). Estimating the probability of identity among

1386   genotypes in natural populations: cautions and guidelines. *Molecular Ecology*, *10*, 249-256.

1387   Waring, G. T., Josephson, E., Maze-Foley, K., & Rosel, P. E. (2015). *U.S. Atlantic and Gulf of*

1388   *Mexico Marine Mammal Stock Assessments -- 2014* (NOAA Technical Memorandum

1389   NMFS-NE-231). U.S. Department of Commerce.

1390   Watanabe, H., Okazaki, M., Tamura, T., Konishi, K., Inagake, D., Bando, T., Kiwadda, H., &

1391   Miyashita, T. (2012). Habitat and prey selection of common minke, sei, and Bryde's whales

1392   in mesoscale during summer in the subarctic and transition regions of the western North

1393   Pacific. *Fisheries Science*, *78*, 557-567.

1394   Weir, C. R. (2010). A review of cetacean occurrence in West African waters from the Gulf of

1395   Guinea to Angola. *Mammal Review*, *40*, 2-39.

1396   Whitt, A. D., Jefferson, T. A., Blanco, M., Fertl, D., & Rees, D. (2011). A review of marine

1397   mammal records of Cuba. *Latin American Journal of Aquatic Mammals*, *9*, 65-122.

1398 Yamada, T. K. (2009). Omura's whale *Balaenoptera omurai*. In W. F. Perrin, B. Würsig, & J. G.

1399   M. Thewissen (Eds.), *Encyclopedia of marine mammals* (Second ed., pp. 799-801).

1400   Academic Press.

1401 Yamada, T. K., Chou, L. S., Chantrapornsyl, S., Adulyanukosol, K., Chakravarti, S. K., Oishi,

1402   M., Wada, S., Yao, C.-J., Kakuda, T., Tajima, Y., Arai, K., Umetani, A., & Kurihara, N.

1403   (2006). Middle sized balaenopterid whale specimens (Cetacea: Balaenopteridae) preserved at

1404   several institutions in Taiwan, Thailand, and India. *Memoirs of the National Science Museum*

1405   *of Tokyo*, *44*, 1-10.

1406 Yamada, T. K., Kakuda, T., & Tajima, Y. (2008). Middle sized balaenopterid whale specimens

1407   in the Philippines and Indonesia. *Memoirs of the National Science Museum of Tokyo*, *45*, 75-

1408   83.

1409 Yoshida, H., Compton, J., Punnett, S., Lovell, T., Draper, K., Franklin, G., Norris, N., Phillip, P.,

1410   Wilkins, R., & Kato, H. (2010). Cetacean sightings in the eastern Caribbean and adjacent

1411   waters, spring 2004. *Aquatic Mammals*, *36*, 154.

1412 Yoshida, H., & Kato, H. (1999). Phylogenetic relationships of Bryde's whales in the western

1413   North Pacific and adjacent waters inferred from mitochondrial DNA sequences. *Marine*

1414   *Mammal Science*, *15*, 1269-1286.

1415 Yusmalinda, N. L. A., Anggoro, A. W., Suhendro, D. M., Ratha, I. M. J., Suprapti, D., Kreb, D.,

1416   & Cahyani, N. K. D. (2017). Species identification of stranded cetaceans in Indonesia

1417   revealed by molecular technique. *Jurnal Ilmu dan Teknologi Kelautan Tropis*, *9*, 465-474.

1418

1419

1420   Figure Legends

1421

1422   Figure 1. Aerial photograph of a Bryde's-like whale in the northeastern Gulf of Mexico. Photo

1423   credit: NMFS SEFSC and NEFSC under MMPA permit.

1424

1425   Figure 2. Bayesian reconstruction of phylogenetic relationships among members of the Bryde's

1426   whale complex based on 375 bp control region alignment. Posterior probabilities > 0.90 are

1427   shown at nodes. Haplotypes with a * indicate individuals morphologically identified to species

1428   by Sasaki et al. (2006) and used to identify the species clades. Length of scale bar is

1429   proportional to the number of nucleotide substitutions per site. GenBank accession numbers as

1430   well as geographic localities where the haplotype has been recorded are included in haplotype

1431   labels (Atlantic Ocean: WNA = western North Atlantic, ENA = eastern North Atlantic, ESA =

1432   eastern South Atlantic, GOMex = Gulf of Mexico, CAR = Caribbean Sea; Pacific Ocean: WNP

1433   = western North Pacific, ENP = eastern North Pacific, WSP = western South Pacific, ESP =

1434   eastern South Pacific, CSP = central South Pacific, ECS = East China Sea, SCS = South China

1435   Sea, SOJ = Sea of Japan; Indian Ocean: NIO = northern Indian Ocean, WIO = western Indian

1436   Ocean, EIO = eastern Indian Ocean; Southern Ocean: SO). See Table S1 for all sequences that

1437   were collapsed to each haplotype.

1438

1439   Figure 3. Images from the whale that stranded January 2019 in the Gulf of Mexico (holotype

1440   specimen USNM 594665, FMMSN1908). (a) ventral view of body; (b, c) right rack of baleen

1441   and close up of anterior portion of the rack; (d) right flipper; (e) ventral and (f) dorsal view of the

1442   fluke. Scale bar is 10 cm. Photos in 3b and 3c were inverted so the dorsal side is up. Photo

1443   credit: Florida Fish and Wildlife Conservation Commission.

1444

1445   Figure 4. Distribution of all sightings and strandings of Bryde's-like whales in the Gulf of

1446   Mexico and Atlantic U.S. EEZ. All visual survey sightings (blue circles) recorded as "Bryde's",

1447   "Bryde's/sei" and '*Balaenoptera* sp." whales during NMFS vessel and aerial surveys from 1992

1448   to 2019, including all sightings listed as "Bryde's/sei whales" or "*Balaenoptera* sp." in the

1449   western North Atlantic and sightings recorded by protected species observers (PSO) on seismic

1450   vessels (yellow circles) that could potentially have been a baleen whale. All strandings recorded

1451   as "Bryde's whales" (red triangle; presence of rostral ridges confirmed in stranding record or

1452   photos) or unconfirmed Bryde's-like whale (black circle; could not confirm presence of rostral

1453   ridges in stranding record), and genetically confirmed Gulf of Mexico Bryde's-like whale (green

1454   square) through May 2019, including the extralimital strandings in the western North Atlantic.

1455   Green polygon represents the core habitat for the Bryde's-like whales in the northeastern Gulf of

1456   Mexico. The 100 m, 200 m, 400 m and 1000 m isobaths and the U. S. EEZ are shown.

1457

1458   Figure 5. Localities of published Bryde's-like whale observations in the greater Atlantic Ocean.

1459   Brown circles represent observations that were also genetically identified as *B. edeni brydei*.

1460   Blue circles represent observations that did not include genetic information. Green polygon

1461   represents core habitat identified in the northeastern Gulf of Mexico.

1462

1463   Figure 6. Deformation to tail stock, possibly resulting from a ship strike in a Bryde's-like whale

1464   from the northern Gulf of Mexico. Photo credit: NMFS SEFSC under MMPA permit.

1465

1466   Figure 7. Images of (a) dorsal, (b) ventral, (c) right lateral, and (d) caudal views of the skull of

1467   Rice's whale (holotype specimen USNM 594665).

1468

1469   Figure 8. Vertex of the skulls of (a) Eden's whale, *B. e. edeni* (RMNH4003), (b) Rice's whale, *B.*

1470   *ricei* (USNM 594665, holotype), (c) Bryde's whale, *B. e. brydei* (CKU HL19990729), and (d)

1471   Omura's whale, *B. omurai* (NSMT M32505). pmx = premaxilla, na = nasal, asp = ascending

1472   process of the maxilla, fr = frontal, oc= occipital.

1473

1474
1475

1476
1477 Table 1. Ten measurements of the skull of USNM 594665 (holotype).

Measurement	Length (cm)	Comments
Condylobasal length	284.4	right side as left premaxilla is broken
Maxillary length	204.5	right side as left premaxilla is broken
Zygomatic width	142.6	
Exoccipital width	101.6	
Occipital condyle width	25.1	
Rostrum width at antorbital notch	86.7	
Maximum nasal width	18.8	
Maximum nasal length	32.9	right side
Occipital shield length	63.6	straight/parallel measurement

1478
1479
1480
1481
1482

1483
1484
1485
1486
1487
1488
1489

Table 2. Characteristic attributes (CAs) analysis of the control region (305 bp) for Bryde's-like whales and Omura's whale identifying 30 diagnostic sites. n: total number of individuals used in the analysis for each taxon. Grayed cells identify sites diagnostic for a species. Nucleotide positions 15536-15818 correspond to the *B. e. brydei* mtDNA genome of GenBank accession number AB201259.

	15536	15554	15556	15563	15564	15565	15569	15573	15574	15575	15578	15585	15588	15592	15605	15608	15609	15613	15616	15621	15623	15624	15660	15671	15672	15735	15756	15769	15816	15818
B. e. brydei (n = 629)	C	A	T	T	T	T	C	T	A	T	A	C	A	T	T	C	T	G	G	A	A	T	T	G	C	A	C	A	C	C
B. e. edeni (n = 67)	*	*	*	C	*	*	*	*	*	*	*	*	*	C	*	*	C	*	T	*	*	*	*	*	*	*	*	T	*	*
GOMx whales (n = 36)	*	*	*	*	C	*	*	*	*	*	T	*	*	*	T	C	*	T	*	G	C	*	*	*	*	G	T	C	T	G
B. omurai (n = 41)	T	G	C	*	*	C	T	C	T	C	G	*	G	*	C	*	C	A	T	G	*	*	C	T	A	*	*	T	*	*

1490 Table 3. Genetic divergence estimates for Bryde's-like, sei and Omura's whales based on the 375

1491 bp alignment of the mitochondrial DNA control region. Number of individuals (n), number of

1492 haplotypes (h). Net between group divergence (d_A, Nei 1987) corrected using the T3P model is

1493 below diagonal, within group divergence is along diagonal, and number of fixed differences

1494 (number of indels) between taxa above the diagonal.

	n	h	GOMx whales	*B. e. edeni*	*B. e. brydei*	*B. borealis*	*B. omurai*
GOMx whales	36	2	*0*	25	24	22 (1)	51 (8)
B. e. edeni	22	5	0.103	*0.009*	20	20 (1)	42 (8)
B. e. brydei	27	15	0.128	0.102	*0.019*	17 (1)	39 (5)
B. borealis	90	10	0.114	0.102	0.083	*0.016*	41 (9)
B. omurai	17	5	0.304	0.229	0.246	0.264	*0.004*

1495
1496

70

Table 4. Compilation of unconfirmed Bryde's-like whale (identified in stranding record as a baleen whale or "Bryde's whale" but no description or photos to confirm presence of rostral ridges), Bryde's-like whale (identified in stranding record as a "Bryde's whale" and with written description or photos to confirm presence of rostral ridges), and verified Gulf of Mexico Bryde's-like whale (confirmed via genetic analysis) strandings in the northern Gulf of Mexico and U.S. eastern seaboard. Lengths are noted as being actual measured length (a) or estimated lengths (e) as noted in the stranding data records.

Catalog Number	Additional Identifiers	Date (mm/dd/yy)	Location	Lat (dd)	Long (dd)	Length (cm)	Sex	Verification	Data and Source for Verification	Additional Citations
Gulf of Mexico										
LSUMZ 17027	STR338	June 1954	Chandeleur Islands, St. Bernard Parish, LA	29.83	-88.83	n/a	n/a	verified GOMx Bryde's-like whale	genetics; present study	Lowery 1974; Mead 1977; Schmidly 1981; Jefferson 1995
MME 2		8/18/82	2 km SE of Isle au Pitre, LA	30.13	-89.18	1,500 (e)	n/a	unconfirmed Bryde's-like whale	no photos or notation of rostral ridges	Jefferson 1995
SEAN 7128		12/25/82	Southwest Pass, LA	29.03	-89.32	1,160 (e)	n/a	unconfirmed Bryde's-like whale	no photos or notation of rostral ridges	Jefferson 1995
MME 1486	SE2250	11/8/85	Chandeleur Islands, Near Palos Island, LA	29.79	-88.89	1,040 (a)	M	unconfirmed Bryde's-like whale	Top of head could not be accessed, cannot confirm ridges present. Ventral grooves reach to umbilicus. Likely Bryde's whale	Jefferson 1995
MME 1939	SE2589, MME01956	10/28/86	Cameron Parish, LA	29.77	-93.33	990 (e)	M	Bryde's-like whale	photos show ridges; Harris 1987	Harris and Richard 1987; Jefferson 1995
MME 5967	SE4790; 90-1-1	1/8/90	Freshwater Bayou Canal, 1/2 Mile West of Mouth, Intracoastal City, LA	29.53	-92.32	1,067 e)	n/a	unconfirmed Bryde's-like whale	no photos or notation of rostral ridges	Jefferson 1995
MME 6574	SE5716, MM9101	1/7/91	1/4 M West of Bunces Pass, Saint Petersburg, FL	27.65	-82.75	1,120	n/a	unconfirmed Bryde's-like whale	no photos or notation of rostral ridges	Jefferson 1995

MME 7822	SE6168, MME7822, DRC-91-09	5/24/91	No Name Key, in Bogie Channel/ Big Pine Key, or Grassy Key, FL	24.72	-81.35	1,140/ 1,158 (e)	n/a	unconfirmed Bryde's-like whale	no photos or notation of rostral ridges	Jefferson 1995
MME 8837	SE8092, LA001-93	6/14/93	Le Petit Pass Island, LA	30.12	-89.43	1,128 (a)	F	unconfirmed Bryde's-like whale	no photos or notation of rostral ridges	
MME 11756	SE4038, SWF-BE-8876-B	11/25/88	Honeymoon Island, off Clearwater, FL	28.08	-82.83	693	F	Bryde's-like whale	photos; Edds *et al.* 1993	Jefferson 1995
STR 339		4/2/65	Panacea, FL	30.03	-84.37	1,158	n/a	Bryde's-like whale	photos; Rice 1965	Lowery 1974; Mead 1977; Shane and Schmidly 1976; Schmidly 1981
STR 1923=STR 2507		1/11/75	West Bay Region Near Venice/ near Tiger Pass, LA	29.12	-89.40	841	M	Bryde's-like whale	visual observation of ridges; Shane and Schmidly 1976	Mead 1977; Schmidly 1981;
USNM 504074	BAP001, CSLP7674	5/29/74	Tarpon Springs, Anclote Key, FL	28.15	-82.77	1,000	M	Bryde's -like whale	photos; Mead 1977	Gunter and Overstreet 1974; Schmidly 1981; Jefferson 1995
UF33536	USNM 593536; MMPL0906; SER09-0394	10/4/09	Tampa Bay, FL	27.91	-82.43	1,265 (a)	F	verified GOMx Bryde's-like whale	genetics; Rosel and Wilcox 2014	
USNM 593537	FLGM110206-32; SER06-575	11/2/06	Walton County, FL	30.37	-86.35	470 (e)	F	verified GOMx Bryde's-like whale	genetics; Rosel and Wilcox 2014	
0521Be	SER05-767	3/28/05	Southwest Pass, LA	28.99	-89.38	914 (a)	F	verified GOMx Bryde's-like whale	genetics; Rosel and Wilcox 2014	
RKB-1403	SE4022	8/20/88	Panama City, FL	30.08	-85.64	450 (p)	unk	Bryde's-like whale	baleen, throat groove location, size; R. K. Bonde unpublished	Jefferson 1995
LSUMZ 033431	LSUMZ03343	2/28/82	near Southwest Pass, LA	29.07	-89.29	n/a	n/a	baleen whale	no photos or notation of rostral ridges	Jefferson 1995
MCT20120326	SER12-0585	3/18/12	North edge of Chandeleur Islands chain, LA	29.98	-88.83	701 (p)	n/a	verified GOMx Bryde's-like whale	genetics; present study	

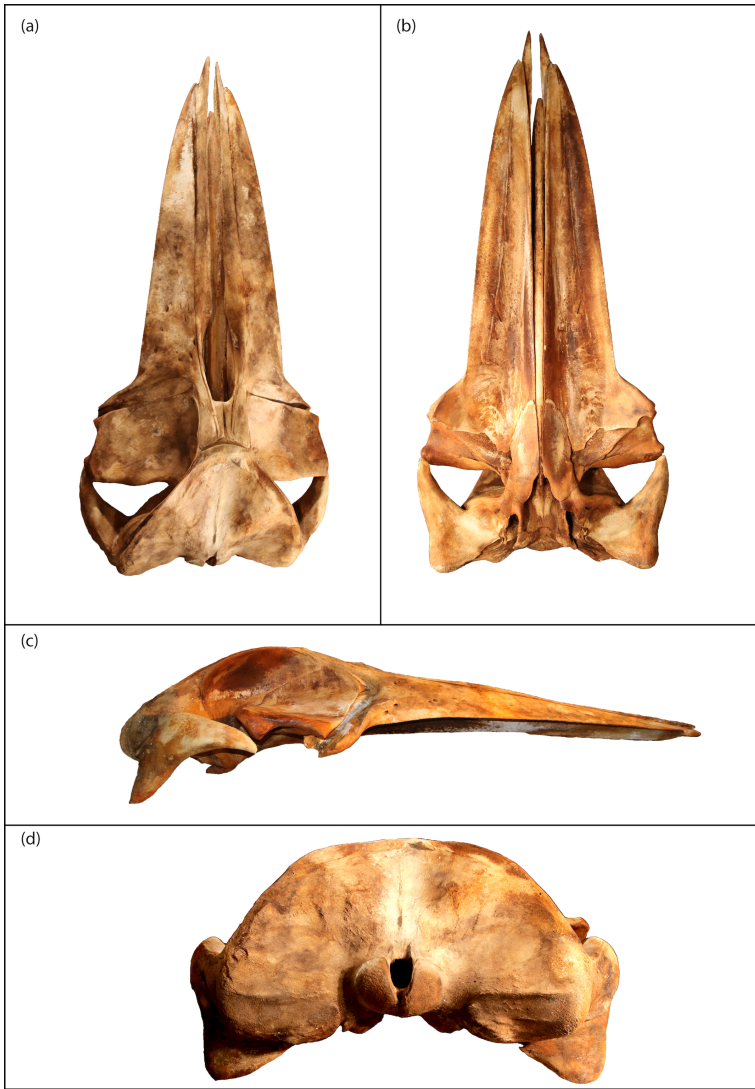|									
SMM20121101	SER12-0771	10/25/12	Lonesome Bayou, SE corner of Breton Sound, LA	29.20	-89.06	780 (p)	M	verified GOMx Bryde's-like whale	genetics; present study	
44DISL091616	SER16-00537	9/15/16	25 miles offshore Louisiana, trawl	n/a	n/a	n/a	n/a	baleen whale	bone only	
USNM 594665	FMMSN1908, SER19-00187	1/29/19	Everglades National Park, FL	25.03	-81.02	1,126 (a)	M	verified GOMx Bryde's-like whale	genetics; present study	holotype
Atlantic										
USNM 239307		3/18/1923	Walnut Point, VA	37.98	-76.47	801-803	M	Bryde's-like whale	photos	Mead 1977
USNM 572922	WAM 587	3/13/03	Carolina Beach, NC	34.07	-77.88	1,105 (a)	M	verified GOMx Bryde's-like whale	genetics; Rosel and Wilcox 2014	
MME 8115	SC-92-1, SE6591	1/24/92	Ash Island, St. Helena Sound, SC	32.5	-80.45	790 (a)	F	verified GOMx Bryde's-like whale	genetics; Rosel and Wilcox 2014	
MME 93	GA83010501	1/5/83	Ossabaw Island, GA	31.74	-81.11	660 (e)	n/a	Bryde's-like whale	Stranding record indicates rostral ridges present	
MME 11032	SE8345, GA83010501	9/18/93	Ossabaw Island, GA	31.87	-81.13	510 (a)	n/a	unconfirmed Bryde's-like whale	Highly decomposed. No photos or notation of rostral ridges	
SEAN 1209		11/6/76	Fort Pierce, FL	27.47	-80.33	559	F	Bryde's-like whale	photos with stranding record	Schmidly 1981
USNM 504768	SEAN3080, SE0028	3/14/78	Fort George Island, FL	30.42	-81.41	869 (a)	M	Bryde's-like whale	photos; Leatherwood and Reeves 1983	Schmidly 1981,
MME 3360		8/30/87	Amelia Island, FL	30.57	-81.45	975	n/a	unconfirmed Bryde's-like unconfirmed Bryde's-like whale	No photos, animal swam away	
SEAN 3212	SE0064, HNN-884,	4/30/78	"Orange Canal between Ogeechee river and Rockfish creek"	31.92	-81.23	950-953	M	unconfirmed Bryde's-like whale	No photos or notation of rostral ridges	Schmidly 1981

Figure 1
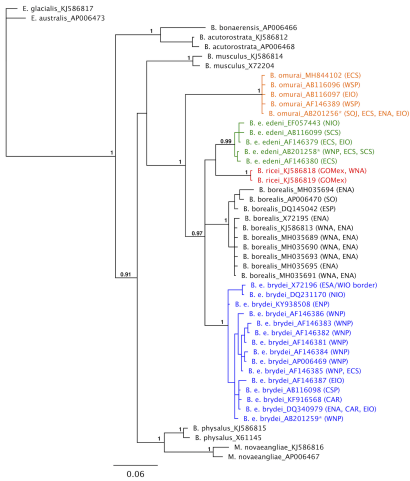
Figure 2
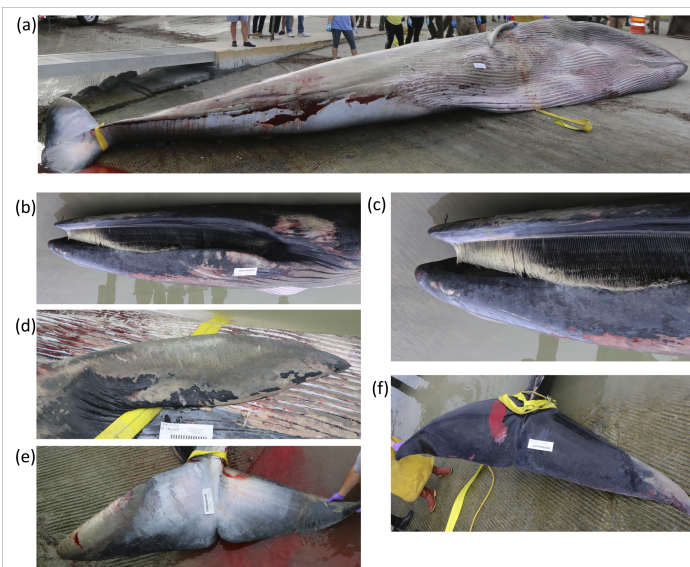
Figure 3
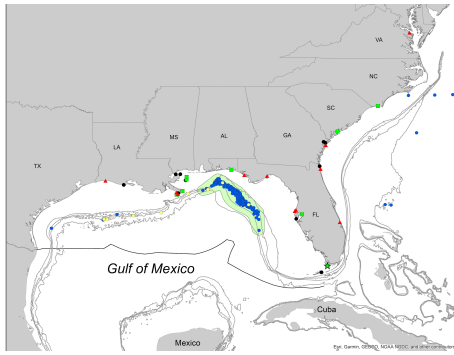
Figure 4

Figure 5

Figure 6

Figure 7

Figure 8