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## Vaquita Face Extinction from Bycatch. Comment on Manjarrez-Bringas, N. et al., Lessons for Sustainable Development: Marine Mammal Conservation Policies and Its Social and Economic Effects.

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### Recommended Citation

Flessa, Karl W.; Calderon-Aguilera, Luis; Cintra-Buenrostro, Carlos E.; Dettman, David L.; Dietl, Gregory P.; Goodwin, David H.; Jacobs, David K.; Kowalewski, Michal; Nelson, Steven M.; Rowell, Kirsten; Schone, Bernard R.; Smith, Jansen A.; and Zamora-Arroyo, Francisco, "Vaquita Face Extinction from Bycatch. Comment on Manjarrez-Bringas, N. et al., Lessons for Sustainable Development: Marine Mammal Conservation Policies and Its Social and Economic Effects." (2019). *Earth, Environmental, and Marine Sciences Faculty Publications and Presentations*. 8.  
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1 *Comment*

2 **Vaquita face extinction from bycatch. Comment on**  
3 **Manjarrez-Bringas et al., Lessons for sustainable**  
4 **development: Marine mammal conservation policies**  
5 **and its social and economic effects. *Sustainability***  
6 **2018, 10, 2185.**

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33 Received: March 20, 2019; Accepted: April 4, 2019; Published: date

34 **Abstract:** We are among the scientists who have documented the environmental and ecological  
35 changes to the Upper Gulf of California following the reduction in the Colorado River's flow. We  
36 object to any suggestion that our research supports Manjarrez-Bringas et al.'s conclusion that the  
37 decline in the Colorado River's flow is the reason for the decline in the population of the endangered  
38 vaquita porpoise (*Phocoena sinus*). Manjarrez-Bringas et al.'s conclusions are incongruent with  
39 their own data, their logic is untenable, their analyses fail to consider current illegal fishing practices,  
40 and their recommendations are unjustified and misdirected. Vaquita face extinction because of  
41 bycatch, not because of the lack of river flow.

42 **Keywords:** Gulf of California, marine mammal, vaquita, *Phocoena sinus*, bycatch, fisheries policy

43

44 **1. Introduction**

45 Manjarrez-Bringas et al. [1] performed a valuable service in characterizing the Mexican fishing  
46 community of El Golfo de Santa Clara's (GSC) demographics, economic activities and attitudes and  
47 perceptions regarding conservation efforts. And they are correct to identify GSC as caught between  
48 the externally forced policies designed to reverse the decline in the population of the vaquita  
49 (*Phocoena sinus*) and the needs of its residents for a viable and sustainable economy. No easy  
50 solutions exist.

51 However, Manjarrez-Bringas et al. [1] (p. 11) assert – but do not cite – “Countless scientific  
52 studies have demonstrated the ecological damage that Mexico has faced due to the damming of  
53 freshwater.” They conclude that the lack of Colorado River flow is the principal cause of the  
54 vaquita's decline. The 13 authors of this comment are among the scientists who have documented  
55 the environmental and ecological changes to the Upper Gulf of California (UGC) following the  
56 reduction in the river's flow. We object to any suggestion that our research supports Manjarrez-  
57 Bringas et al.'s [1] conclusion linking the decline in the Colorado River's flow to the dramatic decline  
58 in the population of vaquita. Given what is known about the biology of vaquita [2-7] and the  
59 documented environmental changes resulting from the lack of river flow [8-23], we conclude that  
60 vaquita face extinction because of bycatch, not the lack of river flow.

61 We are convinced by the research of the past 20 years, e.g., [2-7] that vaquita face extinction  
62 because they drown in gillnets. Manjarrez-Bringas et al. [1] fail to discuss the extensive evidence for  
63 the effects and extent of bycatch, their own data on the effects of fishing restrictions on GSC fishers  
64 are not adequate, their logic is faulty, and they present no direct evidence to support a causal link  
65 between Colorado River flow and the size of the vaquita population.

66 **2. Fishing Restrictions and Productivity**

67 Manjarrez-Bringas et al.'s [1] conclusions regarding the lack of desired effects of the increasingly  
68 restrictive fishing practices on the population of the vaquita are not supported by their own data.  
69 They note three increasingly restrictive limitations on fishing in the UGC: 1. The formation of a  
70 Biosphere Reserve in 1993; 2. The creation of a vaquita refuge in 2005; and 3. The buyout of fishing  
71 permits begun in 2007. The authors imply that because these restrictions did not reverse the decline  
72 in vaquita numbers, the species' decline must be the result of the reduction in the Colorado River's  
73 flow to the Gulf of California.

74 Fishing productivity in GSC does not appear to be affected by these fishing policies. Manjarrez-  
75 Bringas et al. [1] document that fishing production increased from 750 tons in 1987 to more than 4,000  
76 tons in 2002 and that production totaled 21,823 tons in 2007. Either the imposition of geographic  
77 limits on fishing were not enforced or they had no effect on production. Indeed, accounting for the  
78 increase in GSC's population from 1987 (as interpolated from their Table 1) to 2002, and from 2002 to  
79 2007, production per capita increased from 0.57 to 2.44 to 6.47 tons per person. However, the  
80 production figures they use are inconsistent. Their Table 5 lists a total nine-month production for  
81 2007 of 2,182,300 tons – one hundred times greater than the figure reported in their previous  
82 paragraph, and that table reports only on the top four species. Regardless of this error, it appears that  
83 fishing productivity in GSC increased greatly from the formation of the Biosphere Reserve to the  
84 advent of the PACE-vaquita buyout program. No hardship to the community is evident in these  
85 numbers.

86 Johnson et al.'s [24] (p. 1) analysis of fishing effort in the Gulf of California indicated “...the  
87 current number of small-scale fishing boats in the Gulf is approximately double what is required to  
88 land theoretical maximum fish biomass.” and that the communities of San Felipe and GSC are  
89 characterized by anomalously high fishing efforts, given their populations. Any real decrease in the  
90 fishery production at GSC not evident in Manjarrez-Bringas et al.'s [1] published numbers may be a  
91 consequence of over-fishing rather than any effective restrictions on fishing.

92 Manjarrez-Bringas et al. [1] fail to discuss the two-year ban (starting in 2015) on gillnet fishing  
93 in the gillnet exclusion zone [25] and the ban's indefinite extension in 2017 [26]. Even if enforcement  
94 was total, it would not be reasonable to expect the vaquita population to show a dramatic increase in  
95 such a limited time. As Taylor et al. [5] (p. 591) point out "If the vaquita population could grow at  
96 its maximum intrinsic rate, it would not reach 2008 levels (>250 vaquita) until 2050." Recovery will  
97 be slow and protracted.

98 Manjarrez-Bringas et al. [1] report that a total of 235 vessels (assuming that a permit applied to  
99 only a single vessel) were withdrawn from fishing activity through the PACE-vaquita buyout  
100 programs. They do not report, however, how many vessels retained their permits or how many un-  
101 permitted vessels continued to fish; nor do they cite any figures on changes in the number or duration  
102 of trips. An increase in the average number or duration of trips could result in an unchanged – or  
103 even increased – catch. The perceptions of the fishers notwithstanding, Manjarrez-Bringas et al. [1]  
104 provide no data to support the idea that the buyout program decreased fishing activity.

### 105 3. Illegal Fishing and Vaquita Bycatch

106 Manjarrez-Bringas et al. [1] do not mention the increase in the illegal gillnet fishing of totoaba  
107 (*Totoaba macdonaldi*) in the UGC. The gillnets trap and drown vaquita. Dried totoaba swim  
108 bladders are prized in the Chinese market and, according to media reports [27, 28] fetch prices that  
109 are, gram-for-gram, similar to those of cocaine. Prices for totoaba swim bladders are a powerful  
110 economic incentive for illegal gillnet fishing in the UGC. Illegal gillnet fishing in the UGC is a major  
111 cause of vaquita mortality [4, 29, 30]. Tragically, both totoaba and vaquita are endangered species.

112 All the available evidence suggests that both legal and illegal fishing activity have increased,  
113 despite the increasing restrictions. An increase in fishing activity since 1987 likely increased the  
114 inadvertent capture and mortality of vaquita.

115 The failure of fishing policies to reverse the decline of vaquita numbers is not evidence that the  
116 policies are misdirected. Well-designed policies have no effect if local communities are not willing  
117 to adopt them or enforcement is ineffective [31].

118

### 119 4. Effects of Decreasing River Flow

120

121 Manjarrez-Bringas et al. [1] blame the decline of vaquita numbers on the lack of freshwater flow  
122 from the Colorado River. Indeed, since the completion of Glen Canyon Dam in 1963, little river  
123 water has reached the UGC, except during high flow periods in the 1980s and 1990s. But correlation  
124 is not evidence of causation and Manjarrez-Bringas et al. [1] provide no evidence linking the decline  
125 in river flow to the decline of vaquita.

126 The UGC has been affected by the lack of Colorado River flow. Studies based on biogeography,  
127 genetics, stable isotopes, fisheries biology, sclerochronology and analyses of the shelly faunas show  
128 that the Colorado River was a significant influence on the UGC. These studies document the river's  
129 effects on salinity [8-10], ecosystem services [11], benthic productivity and relative abundance [12-  
130 14], growth rates in mollusks [15] and fish [16], distribution of species [17-20] and trophic  
131 relationships [21, 22].

132 We note again that our research does not support Manjarrez-Bringas et al.'s [1] conclusion  
133 linking the decline in the Colorado River's flow to the decline in the vaquita population. There is no  
134 evidence to indicate that restoring the flow of the river to the UGC would restore the vaquita  
135 population. There is ample evidence [2-7] to identify bycatch as the imminent threat to the vaquita's  
136 survival.

137 Manjarrez-Bringas et al. [1] (p. 12) claim that vaquita has "always been an estuary species...", but  
138 do not provide any evidence for this statement. Manjarrez-Bringas et al. [1] (p. 12) also state that  
139 "Between 20 to 25 PSU (Practical Salinity Unit) are suitable for life adapted to estuary environments."

140 First, we note that estuaries are typically defined as "...bodies of water usually found where  
141 rivers meet the sea." [32] – no precise range of salinities defines an estuary. Estuaries are highly  
142 variable environments – salinity varies from season to season and from year to year.

143 Second, Manjarrez-Bringas et al. [1] do not offer any evidence for their supposed range of  
144 vaquita-preferred salinity values for when the Colorado River still flowed to the UGC. The lowest  
145 salinity observed during a 1993 release of approximately 700 m<sup>3</sup>/sec of river water was 32.0 PSU  
146 southwest of Isla Montague, close to the river's mouth [33]. Modeling, based on estimated pre-dam  
147 flows of 2,000 m<sup>3</sup>/sec [34] yielded values less than Manjarrez-Bringas et al.'s [1] arbitrary upper limit  
148 of 25 PSU only up to 30 km from the river's mouth. Proxy estimates of salinity in the era before  
149 upstream dams [10] document salinities lower than 25 PSU only in the vicinity of Isla Montague, at  
150 the river's mouth. The estimated zones of significantly reduced salinity under pre-dam conditions  
151 do not overlap the area of highest observed sightings of vaquitas – the refuge zone (Figure 1 in [1]).  
152

## 153 5. Hypothesis Testing

154  
155 There is no inconsistency in maintaining that the vaquita is suffering from bycatch **and** that the  
156 Upper Gulf's environment has been affected by the decline in the flow of the river [35]. Nature does  
157 not present itself as a carefully controlled experiment where only one variable is changing.

158 Nor is it scientifically valid to treat the alleged failure of one hypothesis (bycatch) as evidence in  
159 favor of an alternative hypothesis (reduced river flow) for the decline of the vaquita. Scientific  
160 hypotheses must stand or fall on the evidence accrued to test their own individual merits.  
161 Manjarrez-Bringas et al.'s [1] own evidence does not disprove the bycatch hypothesis, nor do they  
162 provide any evidence in favor of the reduced river flow hypothesis. By any measure, they fail to  
163 support their own conclusions and recommendations.  
164

## 165 6. Misdirected Recommendations

166  
167 Their recommendations, even if implemented, are not likely to result in the recovery of vaquita.  
168 Indeed, one of their recommendations - to "capture [vaquita] and place in exceptional shelter facilities  
169 of at least 10 specimens of this species..." is misleading. Manjarrez-Bringas et al.[1] submitted their  
170 manuscript more than six months (May 19, 2018) **after** the vaquita capture effort was halted on  
171 November 3, 2017. Capture efforts were called off because of the death of a female vaquita and the  
172 release of a juvenile stressed by its capture [36]. This species of porpoise does not tolerate captivity.  
173 Deliberately suggesting a captivity program after the failure of an extensive and well-supported one  
174 is irresponsible.  
175

## 176 7. Act Now

177  
178 The hypothesis that is best supported by the data continues to be that the decline in the vaquita  
179 population is caused by their drowning in gillnets [2-7]. An enforced ban on gillnet fishing is  
180 essential to vaquita's survival. Alternative fishing gear and alternative economic opportunities are  
181 essential to the communities of the UGC.

182 Action to prevent vaquita extinction needs to happen quickly and must rely on the best scientific  
183 evidence. Bycatch is the problem. To direct efforts toward the unrealistic goal of captivity and the  
184 unsubstantiated cause of decreased river flow is irresponsible. Manjarrez-Bringas et al. [1] are  
185 "merchants of doubt" [37], creating the appearance of uncertainty where none exists. Uncertainty  
186 causes delay; delay will cause extinction.

187 **Author Contributions:** K.W.F. wrote the first draft of the manuscript. All the authors reviewed the draft and  
188 made comments and suggestions for revision. K.W.F. wrote the final manuscript. All the authors approved  
189 the final manuscript.

190 **Funding:** This research received no external funding.

191 **Acknowledgments:** We thank Brooke Bessen and Martha Gomez-Sapiens for discussions.

192 **Conflicts of Interest:** The authors declare no conflict of interest.  
193

194

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