Scientific Review

Prepared by: Dr. John E. Reynolds, III

Senior Scientist, Mote Marine Laboratory

Regarding RIN 1018-AY84

Endangered and Threatened Wildlife and Plants;

12-Month Finding on a Petition to Downlist the West Indian Manatee,

And Proposed Rule to Reclassify the West Indian Manatee

As Threatened

Prepared for and with support from Defenders of Wildlife

Project lead: Elizabeth Fleming

Date submitted: 25 March 2016

Background and Organization of This Report

On January 8, 2016, the U.S. Fish and Wildlife Service ("Service") issued a proposed rule to reclassify the West Indian manatee (*Trichechus manatus*) from endangered to threatened under the Endangered Species Act (Federal Register 2016; page 1000). The proposed rule has two fundamental underpinnings:

1) Population size and status: In recent years, counts of manatees in the United States and Puerto Rico have increased. Consequently, population estimates have also increased. A population viability analysis (PVA) by Castelblanco-Martinez et al. (2012) suggested that the Antillean subspecies (*T.m. manatus*) is a metapopulation with positive growth. A revised Core Biological Model (Runge et al. 2015) also indicated a low likelihood that the Florida subspecies (*T.m. latirostris*) would be reduced to fewer than 4,000 individuals within the next 100 years; and
2) Status and nature of threats: The population information, above, is based on the Service's assumption that current threats will remain constant indefinitely. The Service concluded that threats (including direct threats to manatees and indirect threats affecting habitat extent and quality) are being "addressed and reduced throughout the species' range" (Federal Register 2016; page 1000).

My comments focus on the adequacy of the Service's identification of the best available scientific data to justify downlisting, as well as the adequacy of the scientific analyses the Service relied on in the proposal to downlist. Based on my assessment, I will offer opinions about whether the Service (a) has used the best available data, (b) assessed those data comprehensively and adequately, and c) provided a compelling case to downlist.

This report is organized as follows:

- My credentials as an expert on manatees, manatee research and their conservation;
- Discussion of the thoroughness of the analyses and the validity of conclusions reached by the Service with regard to population size and status;
- Discussion of the thoroughness of the analyses and validity of the conclusions reached by the Service regarding status and nature of threats to West Indian manatees;
- Discussion of the appropriateness of a downlisting recommendation for the West Indian manatee at the species level.

The most complete and scholarly review of the biology, ecology, and conservation of the West Indian manatee is by Marsh, O'Shea and Reynolds (2011). Unless otherwise specified, support of statements made in this expert opinion exists in this book.

My credentials as an expert on manatees, manatee research and their conservation

I graduated Cum Laude with Departmental Honors in Biology from Western Maryland College (now McDaniel College) in 1974. I received my M.S. and Ph. D. degrees in Biological Oceanography from University of Miami's Rosenstiel School of Marine and Atmospheric Sciences in 1977 and 1980, respectively. Both my M.S. thesis and Ph.D. dissertation focused on aspects of the biology of Florida manatees. I was employed at Eckerd College, St. Petersburg, FL from 1980-2001, where I served as Professor of Marine Science and Biology and Chairman of the Natural Sciences Collegium; I was integral in establishing the college's renowned marine science major and remain the only Eckerd faculty member to receive all three of the College's faculty excellence awards for teaching, leadership, and scholarship. In 1989, I became a member of the Committee of Scientific Advisors on Marine Mammals for the U.S. Marine Mammal Commission, the federal agency with oversight for all research and management of marine mammals in the United States. In 1990, I became Chairman of the Committee of Scientific Advisors, and in 1991, I was appointed by President George H. W. Bush to serve as Chairman of the Marine Mammal Commission. I led that agency through mid-2010 under four different administrations (G.H.W. Bush, B. Clinton, G.W. Bush, and B. Obama), and in 2010, the agency's accomplishments were recognized by a distinguished service award by the international Society for Conservation Biology. Since 2001, I have been a Senior Scientist for Mote Marine Laboratory, Sarasota, FL, where I have served as Director of the International Consortium for Marine Conservation and Director of the Center for Marine Mammal and Sea Turtle Research. From 2001-2008, I was co-Chair of the IUCN Sirenian Specialist Group, and from 2006-2008, I served as President of the international Society for Marine Mammalogy. Recently I have worked with the United Nations Environment Programme to develop and implement a Caribbean-wide Marine Mammal Action Plan and an Action Plan for manatees in the wider Caribbean. In recognition of my long-term research and conservation efforts with Alaskan marine mammals and environmental issues, I was given an Eskimo name: Emuqtannee (swimming walrus). I am a member of Phi Beta Kappa; have been nominated for international awards for my accomplishments in conservation and science; and have published more than 300 books, papers, and abstracts.

Thoroughness of the analyses and the validity of conclusions reached by the Service with regard to population size and status

The Service has proposed downlisting for the West Indian manatee throughout its range. In its proposal, the Service provides background information on each subspecies, the Florida manatee and the Antillean manatee. Because these subspecies are not currently separately listed under the ESA, it is incumbent on the Service to base its decision on "the best available scientific and commercial data" with respect to the status of the species as a whole throughout its entire range Hence, the validity of a downlisting proposal must be judged on the manner in which the Service fulfilled that requirement.

For Florida manatees, as well as for Antillean manatees in a small number of range states, counts have recently been higher than in the past. Higher counts, however, do not necessarily mean that populations have increased. It should be noted that high counts can be a product of survey conditions, observer experience, survey design, and survey bias, not simply due to higher or lower numbers of manatees in a specific location. Nonetheless, in Florida in particular, higher counts over time have established minimum population estimates and even an opportunity to assess trends.

Florida manatees

The Service's proposal to downlist provides a good literature review of most aspects of the biology of Florida manatees. One of the important deficiencies in the Service's review, however, concerns sublethal effects of stressors on manatees. For example, Walsh et al. (2005) and Sherwood et al. (2015) have demonstrated that exposure (or repeated exposure) to cold conditions and brevetoxin can lead to long-term consequences for immune function; consequently, a lack of consideration of sublethal effects leads to an inappropriately optimistic perspective for sustainability of manatees. The Service (and Runge et al. 2015) fails to cite or analyze these two important studies. This represents an example in which the best available data regarding an important criterion are simply not comprehensive enough; nonetheless, modelers and the Service should acknowledge that sublethal effects of stressors are likely to impact persistence of manatees in the future, as well as attempt to include such effects into population models.

The document that provides the primary basis for the Service's scientific justification for a positive prognosis for the Florida subspecies is an analysis by Runge et al. (2015). Referred to as the revised Core Biological Model, Runge et al. (2015) provide a comparative Population Viability Analysis (PVA) based on extensive scientific information and an expert elicitation process, as well as a thoroughly-reviewed modelling approach to assess threats. Analyses using PVAs are commonly performed using available software, and the authors include some of the

field's best modelers. Thus, the Service has relied on an analysis by credible individuals using a credible "tool". However, the validity of the results of the PVA or other models depends on the completeness and quality of the data for critical parameters, as well as whether up-to-date information is included. I do not believe that the data used by Runge et al. (2015) were always the best available, and as noted, the model did not consider sublethal effects at all; as a result, certain projected outcomes may be unrealistic and inappropriately optimistic.

Specifically, the Core Biological Model includes questionable assumptions, as well as incomplete analyses of some critical data (e.g., recent unusual mortality events and habitat loss in the Indian River Lagoon). The model considers a number of databases, including some that are at least 6 years out of date, that do not satisfy the criterion of "best available data" as follows:

- Mortality: Runge et al. (2015) do not consider five unusual manatee mortality events that have occurred since 2009. Since 2010 (i.e., over the past 6 years), the death toll for Florida manatees has been 3217 individuals, and annual totals have exceeded 765 manatees in two of those six years. Those data are not factored into the analysis by Runge et al. (2015). In a document with a primary purpose of estimating risk of extinction, failure to include up-to-date mortality data represents a significant shortcoming and a failure to use the best available data.
- Sublethal effects of stressors: as noted above, the Runge model does not consider sublethal consequences of exposure to environmental stressors (cold, brevetoxin, contaminants, noise) and serious injury. Some of those consequences (i.e., to immune function, reproduction, genotoxicity) have been documented and can impair survival and productivity of affected stocks. Given repeated sublethal insults, some manatees may be reaching the point where their survival, reproductive status and performance, and other life history attributes are significantly impacted. These factors are routinely ignored by modelers, but individuals the caliber of Runge and co-authors should at least acknowledge and attempt to quantify that sublethal consequences can decrease sustainability and elevate risk of extinction. Their failure to do so undermines the validity and usefulness of the model to predict future extinction risk;
- Life history: Runge et al. (2004) developed a stage-based model for population dynamics. That document provided important insights, but it is now 12 years old, and is based on data older than that; in fact, analytical results of photo-identification studies included in Runge at al. (2015) are almost a decade old. Especially given poorly documented consequences on life history parameters such as onset of sexual maturation, longevity, and reproductive rate of sublethal effects described above, it is necessary to re-conduct up-to-date analyses of life history parameters for manatees in the various management units. Especially in the wake of several major die-offs, it seems

possible, and perhaps even likely, that life history parameters of Florida manatees may change for the worse in the near future;

- Carrying capacity: carrying capacity (K) of winter habitat was estimated using expert opinion. Although this approach is endorsed by modelers as a means by which to approximate reality, it provides an inexact measure of K. There are peer-reviewed publications that provide a more rigorous assessment of K and extinction probabilities for coastal marine mammals (e.g., for sea otters; see Laidre et al., 2001; Gerber et al. 2004), but that approach has not been used for manatees. Studies such as this need to be cited and recognized as potential templates for additional and informative manatee research.

Some conclusions of the Runge et al. (2015) report are of concern because they are based on assumptions that are quite arguable. Notably, a key finding based on the model suggests that there is a small (2.5%) chance of the Florida manatee population dropping below 4,000 individuals in the next 100 years, but this encouraging result is based on both a lack of inclusion of up-to-date or optimal data, as well as a questionable assumption that current threats will remain constant.

In my opinion, the analysis by Runge et al. (2015) provides results that are credible with regard to current population size and *potential* for population growth, if one makes certain assumptions that are, in fact, questionable (e.g., threats will not increase; life history parameters will not change as a result of repeated exposure to sublethal stressors). With incomplete mortality data, the likelihood of cumulative sublethal effects on health and reproduction, and the consequent possibility of changing baselines for life history parameters, I believe that the proposed extinction probabilities generated by applying the Runge PVA to data that are not up-to-date may be inappropriately optimistic; thus, the model results should be considered with caution and recognized as the best case scenario. Further, possible carrying capacity of warm-water refugia should, in my opinion, be re-assessed using a more applied process than expert opinion.

In short, I do not think that the Service's reliance on Runge et al. (2015) to support the proposed downlisting of the West Indian manatee is consistent with the requirement to rely on the best available scientific data. Nor do I think that some of the data used in analyses were as definitive as is desirable to support as the proposed downlisting of manatees.

Antillean manatees

The publication and model by Castelblanco-Martinez et al. (2012) was not informed by scientific data to the extent that the Runge et al. (2015) analysis was. Instead, as noted by Deutsch et al. (2008), UNEP (2010) and other documents dealing with Antillean manatees, most information on the subspecies is either anecdotal and largely unsubstantiated, or taken from Florida manatee studies, with the largely untested or unlikely assumptions that life history parameters and habitat use are the same for both subspecies. Thus, it is fair to say that the conclusions of Castelblanco-Martinez et al. about population size and trend and other parameters are much less credible than the conclusions from the Runge et al. (2015) analysis, even though (as noted above) the latter is itself compromised by failing to include the best available data.

At least one of the assumptions of the Castelblanco-Martinez model is especially difficult to accept, namely that Antillean manatees throughout the wider Caribbean represent a metapopulation, defined as a group of spatially separated populations of the same species which interact at some level. Given the highly fragmented nature of manatee habitat and distribution, as well as genetic evidence to date, I find that assumption untenable. The reason this is important is that, for a true metapopulation, reductions in numbers in one part of the range may be offset by immigrants from other parts of the range, but if there is no interaction among all groups of a species, local extirpations with no potential for recovery are possible.

It is also interesting that Castelblanco–Martinez et al. (2012) and the Service's downlisting proposal suggest that Antillean manatee numbers are declining or trends are unknown in 16 out of 19 of the range states. Manatee numbers are thought to be stable in only 3 range states, with a cumulative estimated population in these 3 range states of 650 manatees (roughly 12% of the estimate of regional population size; UNEP 2010). Despite presenting such figures, Castelblanco-Martinez et al. suggested that there were approximately 6,700 Antillean manatees (in contrast, UNEP [2010] and Deutsch et al. [2008] suggested a maximum of around 5,600) and reached the conclusion that the metapopulation of Antillean manatees is growing.

In its proposal to downlist, the Service itself indicated that the subspecies' population is believed to be declining or is unknown in 84% of its range. In contrast, Deutsch et al. (2008) suggested that numbers of Antillean manatees were likely to decline by 10% over the next three generations (~60 years), which more generally reflects expert opinion than do the results of the Castelblanco-Martinez et al. (2012) analysis.

The Service failed to consider genetic effects of hybridization with Amazonian manatees (*Trichechus inunguis*) and of limited gene pools and possible inbreeding depression in some range states (see review, Marsh et al. 2011). This is noteworthy because for small and isolated

manatee populations (as occurs in many range states) genetic problems could negatively impact recovery by accelerating local declines.

I find the PVA by Castelblanco-Martinez et al. to provide population analyses that are unsupported by science and that fly in the face of other, more credible syntheses of expert opinion such as Deutsch et al. (2008) and UNEP (2010).

Thoroughness of the analyses and validity of the conclusions reached by the Service regarding status and nature of threats to West Indian manatees

Florida manatees

As acknowledged by Runge et al. (2015), their model does not incorporate important data available after 2009. Therefore, their discussion of threats to habitat and directly to manatees does not include recent unusual mortality events due to cold or to unknown causes in Brevard County, Florida and elsewhere in the Indian River Lagoon or to red tide in southwestern Florida. Furthermore the report does not consider an extensive seagrass die-off in Brevard County, which is arguably the most important habitat for manatees in the world (Reynolds et al. 2015).

The analysis and model by Runge et al. (2015) noted that the authors assumed that threats to manatees would not worsen in the future. It is very difficult to accept such an assumption. For example, the human population of Florida has been projected to increase from around 20 million in 2015 to 26 million in 2030, an astounding 30% increase in just 15 years. It seems inconceivable that such growth in an already-populous state would not create additional environmental threats and degradation. In addition, projected outcomes of climate change such as sea level rise, more hurricanes, stronger hurricanes, and warmer waters (where infectious disease agents can flourish) underscore that escalation of certain threats to manatee habitats and to manatees directly seem likely.

The Service proposal does discuss another habitat-related threat, namely loss of warm water in winter. That problem has been recognized for decades, but remains unresolved and unmitigated. Ineffective or incomplete planning and mitigation associated with loss of warm-water resources (e.g., retirement of power plants; reduction of spring flows) for manatees in winter is a major deficiency and underscores that habitat is not adequately protected in the future. Furthermore, efforts to protect warm-water habitat must, but to date have not, considered necessary networks of resources (Flamm et al. 2012; uncited in the Service's proposal) as much as specific locations. The fact that the Warm-Water Task Force has been dormant for many years underscores that important habitat issues for manatees may be known, but are not being proactively or aggressively managed.

With regard to year-round habitat, Runge et al. (2015) noted the occurrence, but did not factor into their model, the potential effects or consequences of the massive, recent sea grass die off that took place in the Indian River Lagoon (described on the website of the St. Johns River Water Management District, including but not limited to an overview located at: http://floridaswater.com/indianriverlagoon/2011superbloom.html. The worst year was 2011, when 47,000 acres were lost in this area. The seagrasses have yet to recover to pre-die-off

levels, but at present (winter 2016), a new bloom of brown tide (produced by the alga, *Aureoumbra lagunensis*) is underway in the same area. In Laguna Madre, Texas, repeated brown tides significantly affected seagrass density and distribution for several years (Onuf 2000; not cited by the Service in its proposal). With at least 2,000 Florida manatees using Brevard County waters annually (i.e., 1/3 of the estimated population for the subspecies, and 1/6 of the estimated population for the entire species), significant and prolonged reductions in forage could have major consequences for manatee health, survival, and life history.

With an increasing human population, habitat loss, fragmentation and degradation are critical issues to overcome to effect recovery of Florida ecosystems. For example, in addition to problems in the Indian River Lagoon, other coastal areas of Florida (e.g., Florida Bay) are suffering from severe habitat degradation and significant seagrass loss. At present (spring 2016), heavy winter rains have led to the release of polluted water from Lake Okeechobee into rivers or canals in southwestern and southeastern Florida. Impacts have ranged from reductions in water quality to impaired fishing and reduced encounters with wildlife in affected waterways.

Thus, in my opinion, even though some habitat features important to Florida manatees may have improved over time (e.g., restoration of some warm-water springs), the Service's assumptions or conclusions that habitat needed for manatees is safe and assured is unrealistic and is not based on the best available scientific data.

Runge et al.(2015) noted that at least one multi-year unusual mortality event for manatees in Indian River Lagoon is of unknown cause(s). Once again, it seems eminently unsupportable to suggest that threats are under control when scientists cannot determine why some major die-offs occur.

In summary, I do not believe that the best available data demonstrates that threats to manatees at present or in the foreseeable future are fully identified or under control. The Service's questionable assumption that levels of threats to manatees will remain unchanged into the future is not grounded on a full consideration of all available data.

<u>Antillean manatees</u>

UNEP (2010) and other documents indicate that in the wider Caribbean, Antillean manatees face a range of threats related to habitat and to direct killing of the animals. Although all of the range states have protective laws in place for manatees, most of those laws remain poorly enforced or unenforced and thereby generally constitute "paper protection" rather than actual protection.

The Service's proposal to downlist reinforces that habitat fragmentation and loss has been and continues to be the main threat for sustaining the Antillean manatee throughout its range. The proposal does not provide compelling evidence that this situation is changing. In fact, many of the Caribbean range states for the Antillean manatee are poor, developing countries in which habitat protection and species conservation are often impaired by poverty and absence of alternative livelihoods.

Castelblanco-Martinez et al. (2012) considered some threats to manatees in their PVA, but the information they modelled was, once again based on questionable assumptions (e.g., carrying capacity for Antillean manatees is double the current estimated population). Having spent considerable time in the wider Caribbean, it is my belief that direct threats (poaching, disease) and indirect threats (chemical contamination; habitat destruction and fragmentation) are neither well understood nor effectively regulated within the range of the Antillean manatee.

Appropriateness of a downlisting recommendation for the West Indian manatee at the species level

The question is whether the information and analyses the Service has cited to support the proposed downlisting are sufficiently credible to warrant the species as a whole being listed as Threatened under the Endangered Species Act.

***Florida manatees*:**

I do not believe that the Service has based its proposed downlisting on the best available data or complete analyses regarding population size and trend and extinction probability for Florida manatees. I further believe that the Service has based its opinions on analyses that make assumptions that are poorly supported and likely wrong. Thus, I recommend that the proposal to downlist be delayed until up-to-date analyses using conservative/precautionary assumptions are completed (as I describe above).

Antillean manatees

I do not believe that the best available data demonstrates that the Antillean manatees represent a metapopulation. Further I do not believe that the assumptions and anecdotes used to reach a decision of metapopulation positive growth in the Castelblanco-Martinez population viability analysis provides a scientifically reliable projection of population trends or a compelling case for downlisting. I do not believe that the Service has adequately demonstrated threats to Antillean manatees are well controlled, nor is there any assurance that they will be in the future.

West Indian manatee

The ESA indicates that endangered species is one that is in danger of extinction throughout all or a significant portion of its range. As a species, the West Indian manatee warrants endangered status because:

- Manatee abundance is low (estimated to be < 100 individuals) in most range states. Those range states generally rank relatively low on the Human Development Index (HDI), so issues such as poverty and lack of alternative livelihoods may affect survival of manatees in those areas. It is conceivable that West Indian manatees could disappear from as many as half of their current range states within the next 100 years. The Service

itself indicates that in the wider Caribbean population status of manatees is unknown or declining in 84% of the range states. This underscores the possibility of extinction through a significant portion of the range.

- Manatee distribution is already discontinuous throughout much of the wider Caribbean. Loss of manatees from other range states will further isolate certain populations of manatees, adding to their vulnerability.
- The range of threats is high, and the confidence about population levels is low for the West Indian manatee at the species level. Threats are not adequately controlled throughout the range of the West Indian manatee.

In summary, I believe that the potential for the loss of the West Indian manatee throughout a "significant portion of its range" is high. In addition, the Service did not rely on the best available scientific data in its proposal to downlist. I believe that the Service needs to reconsider the issue of possible downlisting including the points I have raised (above) and only after substantial re-analyses that include the best available data.

References:

Castelblanco-Martínez, D.N., C. Nourisson, E. Quintana-Rizzo, J. Padilla-Saldivar, and J.J. Schmitter-Soto. 2012. Potential effects of human pressure and habitat fragmentation on population viability of the Antillean manatee *Trichechus manatus manatus:* a predictive model. Endangered Species Research 18:129-145.

Deutsch, C.J., Self-Sullivan, C. & Mignucci-Giannoni, A. 2008. *Trichechus manatus*. The IUCN Red List of Threatened Species 2008: e.T22103A9356917. http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T22103A9356917.en

Federal Register. 2016. Endangered and Threatened Wildlife and Plants: 12-Month Finding on a Petition to Downlist the West Indian Manatee, and Proposed Rule to Reclassify the West Indian Manatee as Threatened. 81(5) 1000-1026.

Flamm, R.O., J.E. Reynolds, III, and C. Harnak. 2012. Mapping and characterizing the network of warm-water sites used by manatees (*Trichechus manatus latirostris*) along the southwestern coast of Florida. Environmental Management 51(1):154-166.

Gerber, L., K.E. Buenau, and G.R. VanBlaricom. 2004. Density dependence and risk of extinction in a small population of sea otters. Biodiversity and Conservation 13:2741-2757.

Laidre, K.L., R.J. Jameson and D.P. DeMaster. 2001. An estimation of carrying capacity for sea otters along the California coast. Marine Mammal Science 17(2) 294-309.

Marsh, H., T.J. O'Shea, and J.E. Reynolds, III. 2011. Ecology and Conservation of the Sirenia: Dugongs and Manatees. Cambridge University Press.

Onuf, C.P. 2000. Seagrass response to and recovery (?) from seven years of brown tide. Pacific Conservation Biology 5:306-13.

Reynolds, J., J. Provancha, L. Morris, K. Scolardi, and J. Gless. 2015. The Indian River Lagoon (IRL): the world's most important habitat for West Indian manatees is enormously vulnerable. 21st Conf. on the Biology of Marine Mammals, 13-18 December 2015, San Francisco, CA.

Runge, M.C., C.A. Langtimm, and W.L. Kendall. 2004. A stage-based model of manatee population dynamics. Marine Mammal Science 20(3):361-385.

Runge, M.C., C.A. Langtimm, J. Martin, and C.J. Fonnesbeck. 2015. Status and threats analysis for the Florida manatee (*Trichechus manatus latirostris*), 2012. U.S. Geological Survey Open-File Report 2015-1083, 23 p.

Sherwood, T.A., J.E. Reynolds, III, and D.L. Wetzel. 2015. Immune assessment in manatees with cold-stress syndrome. Fifth Florida Marine Mammal Health Conference, 2-4 June 2015, Gainesville, FL.

Walsh, C.J., C.A. Luer, and D.R. Noyes. 2005. Effects of environmental stressors on lymphocytes proliferation in Florida manatees, *Trichechus manatus latirostris*. Veterinary Immunology and Immunopathology 103(3-4):247-256.

UNEP. 2010. Regional Management Plan for the West Indian Manatee (*Trichechus manatus)* compiled by Ester Quintana-Rizzo and John Reynolds III. CEP Technical Report No. 48. UNEP Caribbean Environment Programme, Kingston, Jamaica.