

**CIE Independent Peer Review of
Bumphead Parrotfish (*Bolbometopon muricatum*) Status Review
Biological Review Team: Donald Kobayashi, Alan Friedlander, Churchill
Grimes, Ryan Nichols, and Brian Zgliczynski
August 30, 2010**

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Executive Summary

The BRT review of the scientific data was both exhaustive and comprehensive, based on the best scientific information available. Areas of concern involve interpretation of the reviewed data, rather than any ignorance of existing information on the part of the BRT. These areas of concern involve:

- The effect of size-selective harvesting on population growth and production in a species with only males in the largest size classes, especially if this is due to sex-change.
- The potential lack of connectivity between DSPs, which can mean that local extinctions cannot easily be ameliorated by recruitment from elsewhere. This in turn can affect the decision of whether local extinctions (usually due to overharvesting) result in significant gaps in the range of the species.
- The method for estimating global population size could be improved by applying known density values to the areas where they were found, rather than treating them as if their population densities were unknown.

However, given the BRT's approach and interpretation of the data, I find that the Extinction Risk Analyses are justified.

Background

On January 4, 2010, the National Marine Fisheries Service (NMFS) received a petition from WildEarth Guardians requesting that bumphead parrotfish (*Bolbometopon muricatum*) be listed as endangered or threatened under the U. S. Endangered Species Act (ESA). NMFS reviewed the petition, decided that the petition presented adequate scientific information indicating that an ESA listing may be warranted, and committed to conducting an ESA status review. Because the ESA stipulates that listing determinations should be made on the basis of the best available scientific and commercial information, NMFS formed a Biological Review Team (BRT) comprised of scientists to conduct the status review. The BRT considered a variety of scientific and technical information and produced a draft comprehensive ESA status review of the bumphead parrotfish. This draft report of the review team is the subject of the peer review. The NMFS Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance with the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee.

Description of the Individual Reviewer's Role in the Review Activities

I am Professor of Marine Biology at the University of California, Santa Barbara, and have authored over 130 peer-reviewed scientific publications. My areas of expertise include population biology of coral reef fishes, evolutionary and behavioral ecology of reef fishes, and dispersal/connectivity studies of coastal marine populations. I read the background information

and reports provided for the peer review, including the petition NMFS received to list the Bumphead Parrotfish under the ESA, the NMFS 90 day finding in response to the petition, the ESA Listing Criteria, and many of the 155 references that were included in the information packet. I then conducted a comprehensive peer review of the Status Review of the bumphead parrotfish (*Bolbometopon muricatum*).

Summary of Findings for each Term of Reference

In general, does the Status Review include and cite the best scientific and commercial information available on the species, its biology, stock structure, habitats, threats, and risks of extinction?

I found the review of data to be both exhaustive and comprehensive. I was especially impressed at the efforts made to garner information not only from the peer-reviewed literature, but also from non-published reports and personal communications. The bumphead parrotfish (BHP) occurs over an enormous range, but in scattered, isolated populations that are not all well known. This requires an intense effort at gathering data, and this report is remarkable for the care and dedication that are evident in the acquisition of information.

Are methods used valid and appropriate?

On page 53, it is stated: “Operationally, the GSU area in square km was multiplied by the density estimate in number of bumphead parrotfish per square meter, then the resulting quantity was multiplied by 1000 to accommodate the change in units. This results in an estimate of bumphead parrotfish for a particular GSU.” To accommodate the change in units, the number should be multiplied by 1,000,000, since a square km contains 1,000,000 square m. However, viewing Table 7 and page 52, I think the BRT used BHP per 1000 square meters. So I assume this is a typographical error. If not, the population estimates are in error by three orders of magnitude.

The global population estimates (p 52) arise from bootstrapped values (covering the range of known densities) applied repeatedly to all 59 GSUs. Since actual density estimates exist for 22 GSUs, these estimates should be used for them rather than a randomly applied density estimate. After 5000 iterations, the values for the other GSUs will all tend to the mean value among the density estimates, so it may be simpler to just use this mean value for all unknown-density GSUs. Note that this approach assumes that the current density distributions will always apply, while there is a very real possibility that the frequency of zero and near-zero densities will increase.

Are the scientific conclusions factually supported, sound, and logical?

One area of concern that I have is that because of the possibility of sex change in this species, there may be an underestimate of the effect of removal on the species’ capacity to respond. While Hamilton et al. (2007) suggest that the BHP is essentially gonochoristic, there are no males found at early ages and the largest, oldest individuals are male. (Incidentally, the statement that in sex-changing species, secondary males change sex to become female (p 38) is incorrect.

Secondary males are sex-changed individuals that were previously females.) All testes appear secondary (i.e., with ovarian remnants), so sex change cannot be ruled out (p 38).

While males appear to be present over a wide size range, we do not have data on the size-sex distributions in local populations or social groups. Are males the largest individuals in local social groups? They certainly are in Figure 8 of Hamilton et al., 2008. Mating appears to be in pairs, with a large male dominating. Removal of large males could disrupt spawning, especially if the large male must be replaced through sex change (see Coleman et al., 1996; Alonzo and Mangel, 2004; Muñoz et al. 2010). This could have a severe effect on production (Alonzo and Mangel, 2004).

Group spawning apparently has been observed in this species (Gladstone 1986), so it may well be that pair mating will simply be replaced with groups of smaller males.

Where available, are opposing scientific studies or theories acknowledged and discussed?

Most of the scientific information presented are field surveys or landings data, so there is no issue of opposing data or theory. The review would profit from a consideration of a less optimistic estimation of the degree of connectivity between populations (see below). If the loss of several GSUs would actually result in significant gaps in the range of the species, how might the Extinction Risk Analyses be altered?

Are uncertainties assessed and clearly stated?

The connectivity estimates are very rough, based only on average surface currents, and some of the GSU locations are defined by political rather than biogeographical boundaries. Since the effect of more complex coastal circulation patterns on larval transport are becoming well known (e.g., Siegel et al., 2008), the uncertainty associated with using large-scale circulation models to estimate connectivity has been understated. However, the overall results shown in Figure 13 (largely self-seeding populations) will probably be unaltered by more sophisticated analyses. I stress that a more detailed simulation of connectivity is not possible at this time for the region in question; only the uncertainty has been underestimated.

Thus there may be a need to temper the statement (p 46): “The loss of any one nominal DPS is unlikely to result in a significant gap in the range of the taxon (like most coral reef fishes, the species has successfully evolved via metapopulation connectivity with pelagic propagule dispersal and the loss of any single node or even multiple nodes in this connection network is unlikely to put the population at risk).” Certainly the BHP has spread over its current range through pelagic propagule dispersal. However, we simply don’t know the degree to which most DPSs are presently connected to one another through larval dispersal. Figures 13 and 14 suggest there is very little connectivity between populations, and we simply don’t know if a locally extinct population can be replenished from elsewhere within a 40 or 100 year timeframe.

Evaluate the findings made in the Status Review:

Are the results of the Extinction Risk Analysis supported by the information presented?

Page 65: “The BRT further concluded that, under the formal definition of DPS, the bumphead parrotfish nominal DPSs are not biologically or ecologically significant under the circumstances. To elaborate, none of nominal DPSs are existing in an unusual or unique ecological setting for the taxon (the ecological setting is qualitatively similar throughout the species range). The loss of any one DPS is unlikely to result in a significant gap in the range of the taxon (like most coral reef fishes, the species has successfully evolved via metapopulation connectivity with pelagic propagule dispersal and the loss of any single node or even multiple nodes in this connection network is unlikely to put the population at risk).”

I remain skeptical of this assessment, but there is no guidance given on what constitutes a “significant gap”. If “significant” means that a gap puts “the [global] population at risk” (pp 46 and 65), the local extinction of one or several DPSs will not lead to global extinction of the population, since the DPSs are largely self-seeding (Figure 13) and unlikely to be dependent on other DPSs for supply. By the same token, however, if “significant” means that gaps that are created are unlikely to be filled, local extinctions are unlikely to be rapidly ameliorated by recolonization from other DPSs. As the authors note (p 9): “A species that is not widely distributed across a variety of well-connected habitats will have a diminished capacity for recolonizing locally extirpated populations, and is at increased risk of extinction due to environmental perturbations and catastrophic events”. I am not convinced that the BHP DSPs are well connected.

As mentioned above, I think that, given the current information, it is impossible to gauge whether a local extinction will result in a “significant” gap. However, given population trends reported from human-inhabited areas, it is possible that the bumphead parrotfish could become locally extinct in human-populated areas open to extraction, and will persist only in scattered remote regions. It is unlikely that these remnants will provide sufficient recruits from long-distance dispersal to repopulate the locally extinct areas. The population structure appears to consist of a few isolated remnants where the species is doing well, and large areas of appropriate habitat where the bumphead parrotfish densities are at zero or near-zero. If this structure is consistent with the statement that “bumphead parrotfish nominal DPSs are not biologically or ecologically significant” (p 65), then the authors are correct in their conclusions.

If the large areas of appropriate habitat where the bumphead parrotfish densities are at zero or near-zero are not considered as a significant portion of its range, then the Extinction Risk Analyses are justified. I recognize the inherent limitations of a decision-rule, likelihood point approach to estimating extinction risk, especially when constrained by the standard definitions outlined on pages 4-10. While I may disagree about the extent to which the bumphead parrotfish DSPs are biologically and ecologically insignificant, the BRT approach and analysis is logical and internally consistent, and based on the best available science.

Conclusions and Recommendations

The BRT has done an excellent job of reviewing and synthesizing the best scientific information available on the current status of the bumphead parrotfish. They have been quite clear in delineating their procedures and operating definitions, and they appear to have adhered closely to the ESA listing criteria. Given their procedures and assumptions, their Extinction Risk Analysis is justified.

Appendix 1: Bibliography of materials provided for review

- 1) Petition NMFS received to list the Bumphead Parrotfish under the ESA
- 2) NMFS 90 day finding in response to the petition
- 3) ESA Listing Criteria
- 4) Full pdfs of 155 references (peer-reviewed articles, grey literature, unpublished, and some non-scientific) supplied by the BRT. See http://www.hawaiieod.com/BHP_BRT_PDFs.zip to view these references.
- 5) Bumphead Parrotfish (*Bolbometopon muricatum*) Status Review
Biological Review Team: Donald Kobayashi, Alan Friedlander, Churchill Grimes, Ryan Nichols, and Brian Zgliczynski
August 30, 2010
- 6) Additional references cited in this peer review:

Alonzo, S. H., and M. Mangel. 2004. The effects of size-selective fisheries on the stock dynamics of and sperm limitation in sex-changing fish. *Fishery Bulletin* 102: 1–13.

Coleman, F., C. Koenig, and L. A. Collins. 1996. Reproductive styles of shallow-water grouper, consequences of fishing spawning aggregations. *Environmental Biology of Fishes* 47: 129–141.

Muñoz, R. C., M. L. Burton, K. J. Brennan, and R. O. Parker, Jr. 2010. Reproduction, habitat utilization, and movements of hogfish (*Lachnolaimus maximus*) in the Florida Keys, U.S.A.: Comparisons from fished versus unfished habitats. *Bulletin of Marine Science* 86: 93–116.

Siegel, D. A., S. Mitarai, C. J. Costello, S. D. Gaines, B. E. Kendall, R. R. Warner, and K. B. Winters. 2008. The stochastic nature of larval connectivity among nearshore marine populations. *PNAS* 105: 8974–8979.

Appendix 2: Statement of Work for Dr. Robert Warner

External Independent Peer Review by the Center for Independent Experts

Status Review of Bumphead Parrotfish

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Technical Representative (COTR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.org.

Project Description: A Status Review of the bumphead parrotfish (*Bolbometopon muricatum*) is being conducted by a team at the Pacific Islands Fisheries Science Center pursuant to a petition for NMFS to list the species as threatened or endangered and designate critical habitat under the Endangered Species Act. The draft Report of the review team is the subject of the peer review. The draft report will include a comprehensive presentation and evaluation of information on distribution, biology, abundance trends, threats and risks, information on population structure and genetics, and danger of extinction throughout all or a significant portion of its range. The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**.

Requirements for CIE Reviewers: Three CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. The combination of required expertise of the CIE reviewers shall include working knowledge and recent experience in coral reef fish biology and ecology, fish population dynamics, and quantitative risk assessment of endangered species. Each CIE reviewer's duties shall not exceed a maximum of 10 days to complete all work tasks of the peer review described herein.

Location of Peer Review: Each CIE reviewer shall conduct an independent peer review as a desk review, therefore no travel is required.

Statement of Tasks: Each CIE reviewer shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering Committee, the CIE shall provide the CIE reviewer information (full name, title, affiliation,

country, address, email) to the COTR, who forwards this information to the NMFS Project Contact no later than the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, and other pertinent information. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review.

Desk Review: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. **Modifications to the SoW and ToRs can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator.** The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements.

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

- 1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
- 2) Conduct an independent peer review in accordance with the ToRs (**Annex 2**).
- 3) No later than 15 September 2010, each CIE reviewer shall submit an independent peer review report addressed to the “Center for Independent Experts,” and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and Dr. David Die, CIE Regional Coordinator, via email to ddie@rsmas.miami.edu. Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in **Annex 2**.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

19 August 2010	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
20 August 2010	NMFS Project Contact sends the CIE Reviewers background documents
30 August 2010	NMFS Project Contact sends the Status Report to the peer reviewers
1-14 September 2010	Each reviewer conducts an independent peer review as a desk review
15 September 2010	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
29 September 2010	CIE submits the CIE independent peer review reports to the COTR
4 October 2010	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

Modifications to the Statement of Work: Requests to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the COTR within 10 working days after receipt of all required information of the decision on substitutions. The COTR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of the CIE reviewers to complete the deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW and ToRs. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (CIE independent peer review reports) to the COTR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards:

- (1) each CIE report shall completed with the format and content in accordance with **Annex 1**,
- (2) each CIE report shall address each ToR as specified in **Annex 2**,
- (3) the CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COTR. The COTR will distribute the CIE reports to the NMFS Project Contact and Center Director.

Support Personnel:

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Annex 1: Format and Contents of CIE Independent Peer Review Report

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether the science reviewed is the best scientific information available.
2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR in which the weaknesses and strengths are described, and Conclusions and Recommendations in accordance with the ToRs.
3. The reviewer report shall include the following appendices:

Appendix 1: Bibliography of materials provided for review

Appendix 2: A copy of the CIE Statement of Work

Annex 2: Terms of Reference for the Peer Review

Status Review of Bumphead Parrotfish

Evaluate the adequacy, appropriateness and application of data used in the Status Review document.

1. In general, does the Status Review include and cite the best scientific and commercial information available on the species, its biology, stock structure, habitats, threats, and risks of extinction?
2. Are methods used valid and appropriate?
3. Are the scientific conclusions factually supported, sound, and logical?
4. Where available, are opposing scientific studies or theories acknowledged and discussed?
5. Are uncertainties assessed and clearly stated?

Evaluate the findings made in the Status Review.

1. Are the results of the Extinction Risk Analysis supported by the information presented?

All information associated with the Status Review document is to remain strictly confidential until the Status Review is posted to the PIFSC website and/or the Federal Register by NMFS.