

**Pacific Islands Fisheries Science Center
Program Review of Stock Assessment Process
May 19-23, 2014
Chair's Summary**

Purpose of the Review

This review was called for by the leadership of the National Marine Fisheries Service (NMFS) as part of their science quality improvement plan. During 2014 the stock assessment science programs in all eight NMFS Science centers were reviewed by panelists external to the Pacific Islands Fishery Science center, using identical terms of reference. As described to the panel members, the purpose of the review was to concentrate on identifying the strengths, weaknesses, opportunities and threats to the integrity of the program as part of a continuous process of program improvement.

Review Panel Members

Chair: Dr. Steve Murawski (University of South Florida)
Dr. Yong Chen (University of Maine, Bangor)
Dr. Keith Criddle (University of Alaska, Fairbanks)
Dr. Steve Martell (International Pacific Halibut Commission)
Dr. Cisco Werner (NOAA Fisheries Southwest Fisheries Science Center)
(Figure 1)

Scope of Review

The scope encompassed those assessments conducted in compliance with the Magnuson-Stevens Fishery Conservation and Management Act (2006) and comparable international agreements. The review focused on the overall program of assessment modeling, approach, review process and communication but is not an in-depth review of a particular stock assessment.

The Panel considered materials provided by the Center and further information provided in discussions following the presentations. All presentation material (Powerpoints and background documents) are available at:

http://www.pifsc.noaa.gov/do/peer_reviews/program_review_of_fisheries_stock_assessments_2014.php

The Panel addressed the following seven terms of reference:

1. Does the Center apply a suitable scientific/technical approach to fishery stock assessment modeling?
2. Is the assessment process efficient, effective and clearly described, including terms of reference for assessment reports?
3. Does the Center, in conjunction with other entities such as the Council's Scientific and Statistical Committee (SSC), have an adequate peer review process?
4. Is the Center's program organization effective at accomplishing needed assessments

according to a set of assessment priorities? Include program structure, staffing, and funding; include prioritization of stocks for assessment.

5. Does the Center achieve adequate assessment accomplishments relative to mandates particularly with respect to the number of Fishery Management Plan (FMP) species assessed?
6. Does the assessment program adequately communicate their results, needs, and research?
7. Are there opportunities for improving stock assessments and the stock assessment process?

Summary

Below is provided a **non-consensus summary** produced by the Chair summarizing debate on a number of critical points in several categories:

Overview of Review Meeting:

The stock assessment review occurred over four days (Monday through Thursday), and consisted of presentations from Center leadership and staff, the Pacific Islands Regional Office (PIRO), the Western Pacific Fishery Management Council (WPFMC), a representative from the Western and Central Pacific Fisheries Commission (WCPFC) and comments from the public. The panel was able to interact with each of the speakers and there was sufficient time in the schedule to allow for extensive discussions on the context of the presentations. The review covered the main three assessment areas (large pelagic fishes, the “Deep-7” main Hawaiian Islands bottom fish, and the insular coral reef fishes), as well as issues of staffing, training, productivity, assessment scheduling and stock assessment research. Extensive discussions ensued regarding the adequacy of data for assessments including life history data, fishery-dependent data and fishery-independent survey information. Each of the presenters was asked to provide a “SWOT” (strengths, weaknesses, opportunities and threats) summary for their particular domain. Although public input consisted of but one individual, that person was extremely knowledgeable of the WPFMC process (former chair) and the operations of the fisheries in the main Hawaiian Islands and provided the panel a valuable perspective on the fishery and stock assessments.

Recurrent Findings:

- (1) All of the panelists felt that the process of establishing assessment priorities and terms of reference needed to be more formalized than it is now. Currently, the scope and schedule for individual and collective stock assessments is open-ended, contributing to the feeling among assessment scientists that the workload is increasing with no plateau. Each of the separate management entities for which stock assessments that are produced have their own needs and requirements and each’s demands are increasing. A more formalized process in which the NMFS Regional Administrator, WPFMC Executive Director and the PIFSC Science Director (or their representatives) meet to discuss assessment scheduling and to formalize the “terms of reference” for the stock assessments would set the expectations for the foreseeable future (~3 years) and allow the scheduling of data such as life history studies to be more predictable.
- (2) Peer-review processes in which the Center participates includes the RFMO working groups

and science councils (e.g., WCPFC), and the WPSAR process of the Council. The WPSAR process is new and relatively untested but in theory should be the proper venue to bring two-stage peer reviewed products to the Council's SSC for supporting management decision making.

- (3) The PIFSC is the youngest of the six regional Science Centers at NMFS and the stock assessment group as a formalized entity is correspondingly comprised of a relatively young staff with several senior staff and supervisors. In the past it has been difficult to recruit and retain talented quantitative population dynamicists due to a variety of circumstances including living in a resort area distant to the continental USA. Given the potential for a significantly increased work load from international and domestic demands, it is imperative that talented young scientists be recruited and retained. To this end, the PIFSC has established a formal relationship at UHawaii and supports a faculty person in fisheries ecology. Development of a "home grown" cadre of young people with interest in fish life history and stock assessment will also require that senior staff at the Center participate in training and mentoring students, as the skills necessary for stock assessment scientists are highly specialized and probably beyond the scope of current university faculty.
- (4) Assessments supporting the three stock assessment arenas (large pelagics, "Deep-7" and coral reef fisheries) are critically dependent on accurate life history data for stocks being assessed, including age and growth, maturity parameters and interspecies predation data. Currently, the life history (population biology) program has insufficient throughput of high quality life history data to support this demand. Recognizing that some fishes in this region are difficult to age because of ambiguous annuli on hard parts, it is nevertheless imperative that growth curves and more routine aging be established for managed species. This may take the form of additional tagging studies, age validation studies including biogeochemical techniques and other studies. There is particular concern in this regard for the "Deep-7" complex of species since they are managed as a group, and potential variations in life histories could put some of the components at risk of overfishing. Some combination of assistance from graduate students/faculty and in-house expertise seems a priority.
- (5) Assessment staff produce from 2 to 5 fully reviewed stock assessments per year (Appendix 2), with the most being produced in 2013, and have moderate production of published papers (Appendix 3). If 2-5 assessments per year is the norm for the foreseeable future, then this is a modest level of productivity for the number of staff numbers involved. It was explained that because the staff is on average relatively new to the business, that all members of the team participate in each assessment. This may be fine for the current work load, but if the customers want more, and more frequent assessments, the current model of assignments is unsustainable. In order to increase throughput of assessments, the Center will have to either add stock assessment staff or re-organize into smaller teams of analysts responsible for each assessment.
- (6) In looking across the range of responsibilities for the Center, the large pelagics work primarily supports a large international fishery with relatively low proportions of the catch taken by the United States. That being said, the USA has local interests in the bigeye tuna and assessments in Hawaii, and in the cannery fisheries in the western pacific. In the case of the coral reef fisheries, the relative responsibility of the States and Territories vs. the

federal government (NOAA) for assessments remains unresolved. However, in the case of the Main Hawaiian Islands bottom fish fishery (the “Deep-7”) this is a clear federal mandate with little split jurisdiction domestically or internationally. Because of this clear mandate, it seems that assessment priorities should emphasize this fishery. While the cumulative dockside value is modest, the fishery has strong cultural importance in Hawaii. Thus the “Deep-7” stocks should be assessed well and often.

- (7) With respect to the Deep-7 species, there is an important and unmet need to understand the implications of exploiting and managing them as a complex as opposed to as individual species. Even if the complex management scheme is retained, it would be important to know which species may be most vulnerable due to life history concerns. In theory it is possible to assess the 7 stocks individually, based on biological sampling and catch data. The panel recognizes that modern growth parameters and maturity data are not necessarily available for them all but catch data seem to be available. There is thus an important (urgent) need to undertake biological studies, additional market sampling and other data collection activities leading to the conduct of individual species assessments for the Deep-7. Furthermore, simulation testing prior to the conduct of full assessments should be able to identify the likely range and significance of life history differences.
- (8) It appears that additional market sampling for fish lengths and biological data may be possible through access to fish at the auction. It seems logical, then to increase this cost-effective program.
- (9) Virtually none of the stock assessments are supported by fishery-independent surveys (the exception is shallow water coral reef fishes). Given the inherent biases from using only commercial data, it seems prudent for the Center to fully implement a fishery-independent sampling program emphasizing the Deep-7 species. Candidate gears and methods are being explored by the center, but the sampling has not been densified sufficiently to use this in a management context. As it will take several years of data to make an impact on the assessment, deciding on an approach and moving forward is required in order to improve these assessments.
- (10) The panel discussed the merits of conducting fishery-related survey work in the Northwestern Hawaiian Islands Monument. Since this area has been closed to fishing for at least 5 years, there may be important contrasts in the density and population dynamics that can be inferred from demographic and ecosystem sampling as a comparative study to the main Hawaiian Islands. Since the temperature and productivity conditions are different with distance from the main Islands, the comparisons would need to take this into account. Such comparisons to the “unfished” conditions are potentially useful and these studies could have great scientific value, including understanding the efficacy of fully-protected MPAs. The Center should develop a plan and justification for such activities, should scientists deem them to be important to stock assessment.
- (11) Individual panel members provide more detailed input on specific stock assessments and make recommendations on improving them.
- (12) Because of the large spatial sweep of large pelagic fisheries across the Pacific, and differing trends in apparent fish density in local areas, greater emphasis on spatial dynamics in modeling and assessment is justified. Supporting such metapopulation models, there may be great utility in mounting internationally-supported scientific tagging studies to generate transfer rates for spatially-explicit models.

- (13) Ecosystem modeling activities, although not technically part of the stock assessment activities of the center, can provide important insights into the trophic implications of management reference points and may help explain the high levels of productivity in the face of overfishing for some species (e.g., bigeye tuna). Greater interaction between ecosystem modelers and stock assessment scientists seems prudent
- (14) With respect to international fisheries stock assessment activities supported by the Center, the establishment of the Western and Central Pacific Fisheries Commissions did not result (necessarily) in specific new resources to fund travel and stock assessment work for this new responsibility.
- (15) The PIFSC has traditionally relied on a much higher proportion of foreign-national scientists and students as part of the research program. The heightened security issues and the recent move to the Ford Island military base have exacerbated the difficulties in working with foreign scientists. As this issue is particularly acute in the Pacific Islands, NOAA and DOC should revisit their policies regarding access and streamline them to the extent practicable.

Recurrent Recommendations

- (1) The Science Center, in conjunction with the Regional Office and the Fishery Management Council should develop and implement a formal stock assessment steering committee to establish the assessment schedule and develop formal terms of reference for stock assessments to be conducted. Based on input at the review, the WPSAR Steering Committee is perhaps the obvious venue to act as this steering committee.
- (2) The science and management entities involved (PIFSC, PIRO and WPFMS) should do all they can to ensure that the WPSAR process evolves into an efficient, respected and independent peer review venue for assessing the region's fish stocks.
- (3) NMFS/NOAA/DOC leadership should evaluate their policies regarding foreign scientists working at the PIFSC and do all they can to help facilitate such exchanges to the extent practicable.
- (4) Greater emphasis on training, and especially hosting training programs (e.g., short courses) in the Islands would be cost effective (travel) and is considered a priority for mentoring staff.
- (5) The PIFSC leadership should consider prioritizing resources to increase the throughput of life history data, particularly emphasizing the "Deep-7" bottom fish complex of species. This implies staffing up the life history group either in-house or with expertise from the universities in the region.
- (6) Improvement in specific stock assessments will come with enhanced information on life history (growth), movement data (tagging) and greater emphasis on fishery-dependent and fishery-independent data. Stock assessments are critically dependent on these inputs and the center and NOAA/NMFS should consider additional strategic investments to obtain such data.
- (7) Fishery-independent sampling (especially for the Deep-7 complex) is a priority particularly if the species approach an overfishing/overfished situation.
- (8) Involvement of the NMFS social science program in seeking assistance from the industry in survey design and enhanced fishery-dependent sampling could be helpful in this

cooperative research venture.

- (9) To the extent that comparative ecosystem research would foster improved understanding of managed resources, collaborations with the NWHI Monument allowing access to obtain such data would foster the missions of all concerned and such collaborations are encouraged.

Issues Raised by Member of the Public

- (1) The public (represented by one knowledgeable fisher/former Council member) is rightfully concerned about the status of resources in the region and the quality of stock assessments. The Deep-7 stock complex is difficult to sample and assess, and working with skilled fishermen in collaborative projects will foster communication and observations about these stocks that are unobtainable through traditional data sampling programs. The center's cooperative research program is an obvious source to foster such collaborations.
- (2) The fishery takes place under very specific conditions, and communication with the industry in developing a fishery-independent sampling program for the Deep-7 is thus a priority.

Concluding Comments

This report is a summary of recurrent observations and recommendations by panel members but is NOT a consensus statement on behalf of the panel members. Overall, the Center appears well managed and supports technically sound stock assessment activities to the best of its abilities, given resource limitations imposed on it by Congress and relevant agencies. The Center can move some of its resources around to accommodate recommended changes, but the high proportion of the budget supported by NOAA programmatic funds (e.g., the Coral Reef Program), resources allocated to its academic partner, JIMAR, and externally supported research (e.g., through USAID, etc.) render wholesale changes difficult. Should additional resources become available to support stock assessment activities within the Center, the panel provides some priorities, which basically match those articulated by Center staff. The assessment mission in the western Pacific is becoming increasingly important to the strategic interests of NOAA and the nation, and a vigorous stock assessment capability at the PIFSC should be a priority for the agency. Findings and recommendations contained in the panelist's reports are provided to strengthen the mission and foster a culture of excellence in the assessment group at PIFSC.



Figure 1. Review panel for the Pacific Islands Fisheries Science center (PIFSC). From left to right, Steven Martel, Cisco Werner, Ned Cyr (NMFS, S&T), Young Chen, Rick Methot (NMFS Senior Scientist for Stock Assessment), Steve Murawski (chair), and Keith Criddle.

Appendix 1: Background to the Seven Terms of Reference Supplied by the PIFSC

The following background questions are provided to stimulate thinking with respect to the themes.

1. Scientific/technical approach to fishery stock assessment modeling –
 - a. Is the Center using an appropriate suite of analytical methods to meet the regional fishery stock assessment objectives?
 - b. Does the suite of assessment models cover considerations from data-poor to data-rich?
 - c. Are assessments capable of considering possible ecosystem effects?
 - d. Does the Center work on enhancing and testing these analytical methods? Are they keeping with and contributing to the state-of-the-science nationally and internationally?
2. Is the Center's process for conducting stock assessments efficient and effective?
 - a. Is there an explicit terms of reference for conducting and reporting assessments?
 - b. Do reports provide a complete description of the work and a concise summary?
 - c. Do assessments adequately and incrementally build upon past assessments and reviews?
 - d. Are there clear protocols for delivering draft assessment products to peer reviews?
 - e. Is involvement of assessment scientists in preliminary data preparation and analysis sufficient to utilize their statistical expertise, but not burdensome?
 - f. Are there protocols for consistently dealing with technical issues, as appropriate to the stock, for example: calibration of catchability, consideration of dome-shaped and time-varying selectivity, natural mortality, estimation of stock productivity, characterization of uncertainty, etc.?
 - g. Are there protocols in the assessment process for conducting sensitivity analyses and evaluation of risk?
3. Peer review process
 - a. What is the relative role of the Center and the Council's Scientific and Statistical Committee (SSC) in organizing and conducting the peer review?
 - b. Are TORs for assessment reviews clear and well defined prior to the assessment? Are they focused on key issues needing review? Are they appropriately, but not excessively, broad in scope? Do they focus the review on key, answerable questions?
 - c. Are major data collection programs and modeling methods reviewed separately from the final review of assessments?
 - d. Are there clear protocols for considering and including input from scientists not on the agency assessment team?
 - e. Does the regional peer review process achieve an appropriate balance between transparency, thoroughness, and throughput?
4. Organization and priorities –
 - a. Does the Center/Region schedule stock assessments in a manner that meets national standards and regional needs?
 - i. What protocols are used to prioritize need, frequency and appropriate level of stock assessments?

- ii. Has the Center reasonably balanced Council, other domestic and international stock assessment needs as well as additional analytical and review demands?
 - iii. How well does the Center involve internal and external clients and stakeholders in priority setting and the assessment process?
 - iv. Are the Center's scheduling and scale (e.g., benchmark vs. updates) for individual fishery stock assessments balanced with Center resources, and regional, national and international needs?
 - v. What steps are the primary bottleneck in the number and timeliness of stock assessments each year: surveys, input data processing and management, assembly of assessment reports, ability to address questions from previous assessment, availability of assessment scientists, and review scheduling? Are any excessively limiting?
 - b. Is the Center prioritizing the appropriate initiatives and research areas to address current and anticipated stock assessment needs, including connection of stock assessments to broader ecosystem investigations?
5. Accomplishments relative to mandates
- a. How many FMP and non-FMP stocks are being assessed?
 - b. Do current and planned fishery stock assessments meet regional, national, and international expectations in terms of quality, quantity and timeliness?
 - c. How well does the Center attain a prioritized portfolio of baseline assessments for all managed stocks (including data-poor) and full assessments for important stocks?
 - d. How well does the Center consider ecosystem and environmental factors affecting fish stocks and their assessments?
6. Communication –
- a. Are assessment data needs being communicated to survey scientists, advanced technology experts, and fisheries-dependent data sources; and have improved data resulted from these efforts?
 - b. Are assessment process and results adequately communicated to fishery managers, affected public and the scientific community?
7. Opportunities –
- a. Is the Center conducting the research necessary to improve stock assessments and produce timely and assessment-relevant scientific research products?
 - b. Do assessment scientists engage in research published in peer-reviewed journals?
 - c. Are there areas of expertise that could be added in the future to strengthen the ability of the Center to meet its management and research objectives?
 - d. Should the Center be taking greater advantage of opportunities for collaboration in conducting fishery stock assessments and related research, including shared approaches with other Centers, regional academic partners, other government agency partners, and stakeholders?

Appendix 2. Numbers of fishery stock assessments produced by the Pacific islands Stock Assessment program, 2009-2014.

Assessments

2009 – Hawaiian bottomfish, NP swordfish (2)

2010 – NP swordfish, Pacific Bluefin tuna (2)

2011 – MHI bottomfish, NP albacore (2)

2012 – Territory bottomfish, NP striped marlin, Pacific Bluefin tuna (3)

2013 – NP blue shark, Pacific blue marlin (2)

2014 – MHI bottomfish, NP swordfish, NP albacore, NP blue shark, Pacific Bluefin tuna (5)

Appendix 3. List of publications produced by the Pacific islands Fishery Stock Assessment Program staff, 2013.

2014 and ongoing

Journals and peer-review articles

1. **Chang, Y.J., Brodziak, J., O'Malley, J., Lee, H.H. DiNardo, G.,** Sun, C.L. (in review). Model selection uncertainty and multi-model inference in the generalized fishery production modeling: simulation study of the Pacific blue marlin and WCNPO striped marlin stocks. *Fisheries Research*.
2. Deroba, J.J., Butterworth, D.S., Methot, R.D. Jr., De Oliveira, J.A.A., Fernandez, C., Nielsen, A., Cadrin, S.X., Dickey-Collas, M., Legault, C.M., Ianelli, J., Valero, J.L., Needle, C.L., **O'Malley, J.M., Chang, Y.J.,** Thompson, G.G., Canales, C., Swain, D.P., Miller, D.C.M., Hintzen, N.T., Bertignac, M., Ibaibariaga, L., Silva, A., Murta, A., Kell, L.T., de Moor, C.L., Parma, A.M., Dichmont, C.M., Restrepo, V.R., Ye, Y., Jardim, E., Spencer, P.D., Hanselman, D.H., Blaylock, J., Mood, M., Hulson, P.-J. F. 2014. Simulation testing the robustness of stock assessment models to error: some results from the ICES strategic initiative on stock assessment methods. *ICES Journal of Marine Science*. doi:10.1093/icesjms/fst237.
3. **Lee, H.H.,** Piner, K.R., Hinton, M.G., **Chang, Y.J.,** Kimoto, A., Kanaiwa, M., Su, N.-J., **Walsh, W.,** Sun, C.-L., and DiNardo, G. (in review). Population dynamics and altered sex structure of blue marlin (*Makaira nigricans*) in the Pacific Ocean. *Fisheries Science*.
4. **Lee, H.H.,** Piner, K.R., Methot, R.D. and Maunder, M.N. 2014. Use of likelihood profiling over a global scaling parameter to structure the population dynamics model: an example using blue marlin in the Pacific Ocean. *Fisheries Research*. 158:138-146.
5. **Nadon, M.O.,** Ault, J.S., Williams, I.W., Smith, S.G., **DiNardo, G.T.** (in review). Multi-species stock assessment of Hawaiian coral reef fishes using a length-based methodology applied to diver survey and fishery data.
6. **Nadon, M.O.,** Smith, S.G., Ault, J.S., **DiNardo, G.T.** (in review). An approach to the standardization of high diversity population abundance datasets.
7. Thomas, L.R, **Lee, H.H.,** and **DiNardo, G.** (In review). Productivity and susceptibility analysis of coral reef fish in Guam. NOAA Technical Memorandum.
8. **Walsh, W.A.** and **Brodziak, J.** (in review). Billfish CPUE Standardization in the Hawaii longline fishery: Model selection and multimodel inference. *Fisheries Research*.
9. Wang, S.-P., Maunder, M.N., Piner, K., Aires-da-Silva, A., and **Lee, H.H.** 2014. Evaluation of R0 profiling as a diagnostic for selectivity curve structure in integrated stock assessment models. *Fisheries Research*. 158:158-164.
10. **Brodziak, J.,** J. O'Malley and Y.-J. Chang. **In review.** Multimodel inference for stock assessment. *ICES Journal of Marine Science*.
11. **Brodziak, J.,** M. Mangel, and C.-L. Sun. **In prep.** Estimating probable values of stock-recruitment steepness using life history parameters. *Fisheries Research*.

Working papers

1. Chang, Y.J., Yau, A.J.Y., Brodziak, J., 2014. Stock assessment of Western and Central North Pacific Ocean swordfish (*Xiphias gladius*) through 2012. Intercessional Workshop of the Billfish Working Group of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC). February 11-19, 2014. Honolulu, Hawaii, USA. ISC/14/BILLWG-1/02.
2. Tagami, D., Wang, H., Chang, Y.J. 2014. Spatial distribution of swordfish catches for longline fisheries in the western and central North Pacific and eastern Pacific Ocean. The ISC Billfish Working Group. Honolulu, Hawaii, February 11-19, 2014. ISC/14/BILLWG-1/03.
3. Walsh, W.A. and J. Brodziak. 2014. Catch rate standardization for swordfish *Xiphias gladius* in the shallow-set sector of the Hawaii longline fishery, 1995–2012. ISC/14/BILLWG-1/05.
4. Walsh, W.A. and G. DiNardo. 2014. Blue shark catch rates in the Hawaii-based pelagic longline fishery in 2000–2012: A re-evaluation of observer catch data and standardizations for both fishery sectors. ISC/14/SHARKWG-1/06.
5. Yau, A.J.Y., Chang, Y.J., Brodziak, J., 2014. Stock assessment of swordfish (*Xiphias gladius*) in the Eastern Pacific Ocean through 2012. Intercessional Workshop of the Billfish Working Group of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC). February 11-19, 2014. Honolulu, Hawaii, USA. ISC/14/BILLWG-1/01.

2013

Journals and peer-review articles

1. **Brodziak, J.** and **Walsh, W.A.** 2013. Model selection and multimodel inference for standardizing catch rates of bycatch species: a case study of oceanic whitetip shark in the Hawaii-based longline fishery. *Canadian Journal of Fisheries and Aquatic Sciences*. 70:1723–1740.
2. **Chang, Y.J.**, Sun, C.L., Chen, Y., Yeh, S.Z., **DiNardo, G.**, and Su, N.J. 2013. Modelling impacts of environmental variation on the habitat suitability of swordfish, *Xiphias gladius*, in the equatorial Atlantic Ocean. *ICES Journal of Marine Science*. doi:10.1093/icesjms/fss190.
3. Chang SK, **DiNardo G**, Farley J, **Brodziak J**, Yuan ZL. 2013. Possible stock structure of dolphinfish (*Coryphaena hippurus*) in Taiwan coastal waters and globally based on reviews of growth parameters. *Fisheries Research* 147: 127-136. DOI: 10.1016/j.fishres.2013.05.003.
4. **Lee, H.H. et al.** 2013. Stock assessment of blue marlin in the Pacific Ocean in 2013. CIE review document. <http://isc.ac.affrc.go.jp/pdf/ISC13pdf/Annex%2010-%20Blue%20marlin%20stock%20assessment.pdf>
5. Mangel M, MacCall AD, **Brodziak J**, Dick EJ, Forrest RE, Pourzand R, Ralston S. 2013. A perspective on steepness, reference points, and stock assessment. *Canadian Journal of Fisheries and Aquatic Sciences*. 70:930-940. DOI: 10.1139/cjfas-2012-0372.
6. **O'Malley, J.M.** and **Walsh, W.A.** 2013. Annual and long-term movement patterns of spiny lobster, *Panulirus marginatus*, and slipper lobster, *Scyllarides squammosus*, in the Northwestern Hawaiian Islands. *Bulletin of Marine Science*. 89:529-549.
7. Piner, K.R., **Lee, H.H.**, Taylor, I., Kanaiwa, M., and Sun, C.-L. 2013. Population dynamics and status of striped marlin (*Kajikia audax*) in the western and central North Pacific Ocean. *Marine and Freshwater Research*. 64: 108-118.
8. Sun, C.L., Yeh, S.Z., **Chang, Y.J.**, Chang, H.Y., and Chu, S.L. 2013. Reproductive biology of female bigeye tuna *Thunnus obesus* in the western Pacific Ocean. *Journal of Fish Biology*. 83(2): 250-271.
9. Su, N.J., Sun, C.L., Punt, A.E., Yeh, S.Z., Chiang, W.C., **Chang, Y.J.**, and Chang, H.Y. 2013. Effects of sexual dimorphism on population parameters and exploitation ratios of blue marlin (*Makaira nigricans*) in the northwest Pacific Ocean. doi: 10.1051/alr/2012039.
10. Su, N.J., Sun, C.L., Punt, A.E., Yeh, S.Z., **DiNardo, G.**, and **Chang, Y.J.** 2013. An ensemble analysis to predict future habitats of striped marlin (*Kajikia audax*) in the North Pacific Ocean. *ICES Journal of Marine Science*. doi:10.1093/icesjms/fss191.
11. **Thomas, L.R.**, **DiNardo, G.**, **Lee, H.H.** Piner, K.R. and Kahng, S.E. 2013. Factors influencing the distribution of Kona crabs *Ranina Ranina* (Brachyura: Raninidae) in the main Hawaiian Islands. *Journal of Crustacean Biology*. 33(5): 633-640.
12. Zgliczynski, B.J., Williams, I.D., Schroeder, R.E., **Nadon, M.O.**, Richards, B.L., Sandin, S.A. 2013. The IUCN Red List of Threatened Species: an assessment of coral reef fishes in the US Pacific Islands. *Coral Reefs*. 32: 637–650.
13. Simon, M., J. Fromentin, S. Bonhommeau, D. Gaertner, **J. Brodziak**, and M. Etienne. 2012. Effects of Stochasticity in Early Life History on Steepness and Population Growth Rate Estimates: An Illustration on Atlantic Bluefin Tuna. PLOS ONE, Vol. 7(10):1-17.

14. Andrews, A. H., E. E. DeMartini, **J. Brodziak**, R. S. Nichols, and R. L. Humphreys. 2012. A long-lived life history for a tropical, deepwater snapper (*Pristipomoides filamentosus*): bomb radiocarbon and lead–radium dating as extensions of daily increment analyses in otoliths. *Can. J. Fish. Aquat. Sci.* 69: 1850–1869.
15. Brodziak, J., J.M. O’Malley, B. Richard, G. DiNardo. 2012. Stock assessment update of the status of the bottomfish resources of American Samoa, the Commonwealth of the Northern Mariana Islands, and Guam, 2012. NOAA Administrative Report H-12-04.
16. Iacchei, M., J.M. O’Malley, R.J. Toonen. 2013. After the gold rush: population structure of spiny lobsters in Hawai’i following a fishery closure and the implications for contemporary spatial management. In review. *Bulletin of Marine Science*, Volume 90, Number 1, January 2014, pp. 331-357.
17. Meyer, C.G., Joseph M. O’Malley, Yannis P. Papastamatiou, Jonathan J. Dale, Melanie R. Hutchinson, James M. Anderson, Mark A. Royer, Kim N. Holland, 2013. Growth and Maximum Size of Tiger Sharks (*Galeocerdo cuvier*) in Hawaii. *PLoS ONE*,
18. Simon M., Fromentin, J.M., Bonhommeau, S., Gaertner, D., **Brodziak, J.**, and Etienne, M.P. 2012. Effects of stochasticity in early life history on steepness and population growth rate estimates: an illustration on Atlantic bluefin tuna. *PLoS ONE*. 7(10): e48583

Working papers

1. REPORT OF THE BILLFISH WORKING GROUP WORKSHOP, International Scientific Committee for Tuna and Tuna-like Species In the North Pacific Ocean, 16-23 January 2013 Honolulu, Hawaii, USA.
2. REPORT OF THE BILLFISH WORKING GROUP WORKSHOP, International Scientific Committee for Tuna and Tuna-like Species In the North Pacific Ocean, 20-28 May 2013, Shimizu, Japan.
3. Brodziak, J. 2013. Combining information on length-weight relationships for Pacific blue marlin.
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