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Proposal Submission to

Virginia Marine Resources Commission, RFAB Grant Program

By

THE VIRGINIA INSTITUTE OF MARINE SCIENCE
COLLEGE OF WILLIAM AND MARY

Understanding the Virginia Cobia Stock Through Analysis of Trophy Fish

Kevin Weng
Principal Investigator

John Graves
Chair, Fisheries

Susanna Musick
Co-Principal Investigator

Tom Murray
Associate Director for Advisory Services

John Hoenig
Co-Principal Investigator

Constance M. Motley
Assistant Director of Sponsored Programs

Dr. Mark Luckenbach
Associate Dean for Research and Advisory Services

6 June 2016

VIRGINIA SALTWATER RECREATIONAL FISHING DEVELOPMENT FUND
SUMMARY PROJECT APPLICATION

Please complete all fields. This page should be used as a coversheet for a detailed application.

NAME AND ADDRESS OF APPLICANT:

Mark Luckenbach, Constance Motley
Virginia Institute of Marine Science
1375 Greate Road, Gloucester Point VA

PROJECT LEADER (name, phone, email):

Kevin C. Weng - Assistant Professor
(804) 684-7372 kevinweng@vims.edu

DESCRIPTIVE TITLE OF EVENT:

Understanding the Virginia Cobia Stock Through Analysis of Trophy Fish

PROJECT LOCATION:

VIMS

BRIEF PROJECT SUMMARY: (include a detailed description of activity as an attachment)

After large apparent increases in recreational catch the cobia fishery was closed in federal waters, with states considering similar action. We propose to use existing recreational catch records to evaluate change in maximum size of cobia over time, which is known to be a sensitive indicator of stock status. Cobia maximum size data will be obtained from charter captain records, fishing clubs, Citations, VIMS tagging program records, as well as MRIP. Several published methods will be used to develop stock indices. A strong decline in maximum size of cobia through time will indicate heavy fishing pressure, while a steady maximum size will indicate a healthy population.

EXPECTED BENEFITS: (Describe how your project directly benefits the average Virginia recreational angler)

National Standard 4 (Allocation between states) is likely to be violated by summer closures because more southerly states have an earlier cobia run, and the summer closure disproportionately harms anglers in Virginia. Means to understand the status of the cobia stock in Virginia are urgently needed to determine if the closure is necessary. Additional indices of stock status can be developed using max size, and provided to VMRC, SEDAR and other interested parties. Results will be useful to managers in decisions regarding the possible fishery closure.

SUMMARY COSTS: (Please attach a detailed budget including all sources of recipient funding)

SUMMARY COSTS

Requested VMRC Funding:	**$ 63,249**
Recipient Funding:	**$ 37,049**
Total Costs:	**$ 100,298**

*This form alone does not constitute a complete application, see application instructions or contact Alicia Nelson at 757-247-8155 or alicia.nelson@mrc.virginia.gov

Title: Understanding the Virginia Cobia Stock Through Analysis of Trophy Fish

Personnel	Time	Monthly	**Agency**	**VIMS**	**Total**
Faculty and Staff					
Weng	1.00	$8,302	$8,302	$4,151	$12,453
Musick	0.50	$5,692		$2,846	$2,846
Hoenig	0.50	$14,665		$7,333	$7,333
	-	$0	$0	$0	$0
	-	$0	$0	$0	$0
	-	$0	$0	$0	$0
	-	$0	$0	$0	$0
Hourly					
	-	$0	$0	$0	$0
	-	$0	$0	$0	$0
Graduate Research Assistant					
Crear	####	$1,971	$23,646	$0	$23,646
	-	$0	$0	$0	$0
Personnel, salaried			$8,302	$14,330	$22,632
Personnel, hourly			$0	$0	$0
Personnel, grad assist			$23,646	$0	$23,646
Fringe, 40% salaries;			$3,321	$5,732	$9,053
7.65% hourly			$0	$0	$0
Total Personnel			$35,269	$20,062	$55,331
Communications/Printing			$0	$0	$0
Supplies			$1,000	$0	$1,000
Consultant/Skilled Services			$0	$0	$0
Travel			$1,500	$0	$1,500
Subaward Agreements					
Name of Subaward Agency			$0	$0	$0
Name of Subaward Agency			$0	$0	$0
Tuition			$15,838	$0	$15,838
Vessels			$0	$0	$0
VIMS Communications/Publication Center			$200	$0	$200
Nutrient Analysis			$0	$0	$0
Seawater Research Lab			$0	$0	$0
Equipment			$0	$0	$0
SUBTOTAL: Direct Costs			$53,807	$20,062	$73,869
Facilities & Administrative Costs		**25.0%**	$9,442	$16,987	$26,429
TOTAL			**$63,249**	**$37,049**	**$100,298**

Title Page

Title: Understanding the Virginia Cobia Stock Through Analysis of Trophy Fish

A proposal to the Virginia Marine Resources Commission, RFAB Grant Program, 2600 Washington Avenue, Third Floor, Newport News, VA 23607

Names and Institutions of Investigators

Principal Investigator: Kevin Weng, Assistant Professor, Dept. of Fisheries Science, Virginia Institute of Marine Science, College of William & Mary, 1375 Greate Road, Gloucester Point, VA 23062. kevinweng@vims.edu. 804-604-7372

Co-Investigator: Susanna Musick, Virginia Institute of Marine Science, College of William & Mary, 1375 Greate Road, Gloucester Point, VA 23062.

Co-Investigator: John Hoenig, Professor, Dept. of Fisheries Science, Virginia Institute of Marine Science, College of William & Mary, 1375 Greate Road, Gloucester Point, VA 23062.

Institutional Representatives

Mark Luckenbach, Professor, Director of Research and Advisory Services, (804)-684, luck@vims.edu, Virginia Institute of Marine Science, POB 1346, 1375 Greate Road, Gloucester Point, VA 23062

Constance Motley, Interim Director, Sponsored Programs, VIMS, (804) 684-7029, mfonner@vims.edu, POB 1346, 1375 Greate Road, Gloucester Point, VA 23062

This is a 1-year proposal.

NEED: After large apparent increases in recreational catch the cobia fishery was closed in federal waters, with states considering similar action. National Standard 4 (Allocation between states) is violated because more southerly states have earlier cobia run, and the summer closure disproportionately harms anglers in Virginia. Means to understand the status of the cobia stock in Virginia are urgently needed to determine if the closure is necessary.

OBJECTIVE: Use existing recreational catch records to evaluate change in maximum size of cobia over time, which is known to be a sensitive indicator of stock status.

EXPECTED RESULTS: A strong decline in maximum size of cobia through time will indicate heavy fishing pressure, while a steady maximum size will indicate a healthy population. Results will be useful to managers in decisions regarding the possible fishery closure.

APPROACH: Cobia maximum size data will be obtained from charter captain records, fishing clubs, Citations, VIMS tagging program records, as well as MRIP. Several published methods will be used to develop stock indices. A temporal decline in max size will be interpreted as a sign of high fishing pressure.

1 Need

1.1 The cobia fishery

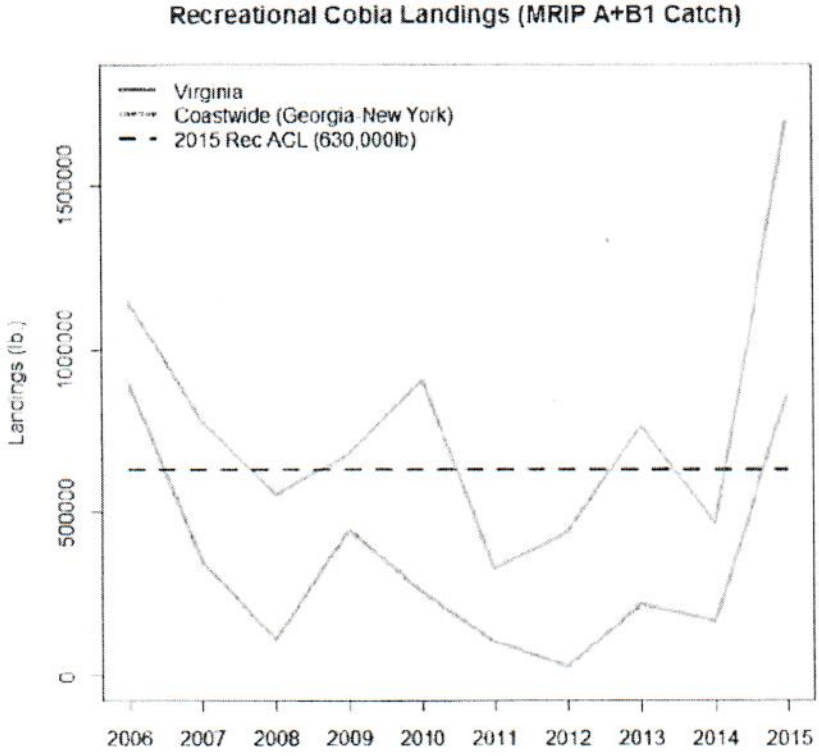
Cobia (*Rachycentron canadum*) is an important recreational and aquaculture fish throughout the world, and a major recreational resource in Virginia. Cobia has become a popular sport fish along the mid and south Atlantic, as well as in the Gulf of Mexico (GOM) (Brown-Peterson et al., 2000). Cobia range from North and South Carolina to Florida and the GOM; however in the warmer months cobia can extend up into New England (SEDAR, 2013). Cobia are thought to be split into two genetically separate populations with the south Atlantic population ranging from parts of Florida (north of Cape Canaveral) to New York and the GOM population spanning the GOM and southern parts of Florida (south of Cape Canaveral) (SEDAR, 2013). In the south Atlantic, cobia migrate northward in the spring and early summer to spawn in bays and estuaries in North and South Carolina and within Chesapeake Bay, Virginia (Darden et al., 2014), while in the GOM, cobia migrate from southern Florida to their spawning and feeding grounds in the northern GOM (Meyer and Franks, 1996). Currently cobia are managed jointly by the South SAFMC and GMFMC as two genetically distinct populations, with the south Atlantic population ranging from Cape Canaveral, FL to NY and the GOM population spanning south of Cape Canaveral, FL to the GOM (SEDAR, 2013).

1.2 Recent developments in the Cobia fishery in Virginia

The 2012 SEDAR stock assessment concluded that the south Atlantic spawning stock biomass of cobia in recent years (2007 & 2009) has been approaching overfishing. SEDAR also stated that it appears regional fishing pressure has increased as well. South Carolina's Department of Natural Resources is concerned that we may be observing hyperstability (Erisman et al., 2011) in the cobia fishery where spawning aggregations are fished so fishing appears to be good until the catch drops drastically (Pers. Comm. M. Denson).

Large increase in recreational catch in recent years (see graph) caused the Federal Government to close the recreational cobia fishery in federal waters starting 20 June 2016. This action resulted in a great deal of controversy including a letter from Congressman Robert Wittman to NOAA. The stakes for Virginia are high because the migratory nature of cobia means that more southerly states can get a season in before the closure, whereas Virginia will lose most of its season. The potential harm to Virginia anglers is relevant under National Standard 4 - Allocation between states.

Virginia and North Carolina both decided to use a management approach that does not fully comply with the federal closure.



A graph of cobia landings distributed by VMRC as part of the FISHERIES MANAGEMENT DIVISION EVALUATION, 05/24/2016 (Figure 1 of Attachment 6, March 17 FMAC Meeting)

1.3 Stock assessment approaches for data-limited fisheries

Advanced model-based stock assessment typically requires three types of data: catch; effort (or abundance); and size or age composition. Such approaches are typically used in large fisheries that have major research programs supporting them. When not all three data types are available, model-based approaches often perform poorly, and when only one type is available, the fishery is considered to be data-poor (Berkson and Thorson, 2015). In data-poor fisheries, management may be more likely to achieve sustainability by using model-free approaches (Berkson and Thorson, 2015), which employ a single data type, such as length-frequency, to create an indicator time series that is used in a prescribed management procedure (Butterworth et al., 1997). These simple indicators may be more sensitive to changes in stock status than CPUE and advanced model-based indicators, rapidly detecting responses to management actions (Erisman et al., 2014). In fact, a comprehensive analysis revealed that both the data-intensive CPUE approach, and the data-limited body-length approach, are effective in the estimation of fishing mortality (Ault et al., 2014). The authors also noted that both CPUE and size-composition are related to stock productivity in population dynamics theory.

Two important indicators used in model-free management procedures are length of individual fish, and differences (in abundance or size structure) between fished and unfished areas (Berkson and Thorson, 2015). Mean length can be used as an indicator, but is perhaps too simplified, because a strong recruitment pulse will reduce mean length, giving a false impression of an

overfished state (Gedamke, 2007; Quang Huynh et al., 2015), though recruitment trends in Florida introduced limited bias (Ault et al., 2005), so the effect may not necessarily be strong.

Another key indicator of stock status that can be used for data-limited fisheries is the percentage of mature fish in the catch (Edwards et al., 2012; Froese, 2004). The percentage of 'megaspawners' in the catch has been proposed as a simple, model-free indicator of stock status (Froese, 2004). For fisheries that have strong size selectivity, percent megaspawners in catch may not equal percent megaspawners in the population.

While average length may be a good indicator for model-free management, there are situations in which indicators may be insensitive to changing stock status, ie., hyperstability (Erisman et al., 2011; MacCall, 1976). Size-selective fisheries may compensate for changing size structure in the population in order to maintain the desired body size in the catch. Length-frequency data that include larger size classes missing from catch data can be critical in estimating spawning potential, because many species show increased duration and frequency of spawning in larger, older individuals (Lowerre-Barbieri et al., 2011).

A central tenet of fishery management is that compensatory growth occurs in harvested populations, so productivity is maximized when a large portion of the standing stock is taken. However, there are two critical mechanisms by which such a process may be broken. The truncation of age structure diminishes resilience to periods of poor recruitment (Longhurst, 2002; Murphy, 1967); and it removes the 'megaspawners' or big old fat fecund female fishes (BOFFFFs) (Beldade et al., 2012; Hixon et al., 2014; Saenz-Agudelo et al., 2015).

Species that experience high variability in recruitment success, often over inter-annual time scales, derive major bet hedging benefits from a broad age structure in the population (Longhurst, 2002). Many marine fishes fit this pattern, and coral reef fishes are perfect examples, having long lifespans, and predominantly pelagic larval phases that introduce great variability in survival. The recent strong year classes of cobia demonstrate this effect.

Fishing can alter the selective factors acting on a population, favoring different traits, some of which may be destabilizing (Hsieh et al., 2006). For instance, fishing can select for earlier maturation and smaller body size (Allendorf and Hard, 2009), sex transition at smaller sizes for sequential hermaphrodites (Green, 2008; Trippel, 1995), and decrease larval size at hatch and thus larval survival (Johnson and Hixon, 2011). For species such as the gonochoristic mutton snapper, it is simply the removal of large females from the population that can have the greatest effect. For protogynous sequential hermaphrodites such as the red hind, larger individuals tend to be male, so the BOFFFF removal effect is less clearcut. However, evolutionary pressures caused by fishing may result in earlier sex change and smaller sizes, meaning that smaller females comprise the spawning stock.

The BOFFFF phenomenon may be important for cobia where the small fraction of individuals that are trophy sized females may represent a disproportionate fraction of total spawning potential. Furthermore, maternal effects are important in offspring success and recruitment (Hixon et al., 2014; Mousseau and Fox, 1998).

Some fisheries are sustainable, but lack megaspawners due to a combination of size limits and high fishing mortality (fish are captured after maturity, but not allowed to grow old) (Erisman et al., 2014). This indicates that spawning output could be much higher if some individuals escaped

the fishery. Management strategies that can preserve natural age structure in a population therefore have benefits across the board, from production, to stability, to evolution.

1.4 Present assessment approach

SEDAR28 used three approaches, combining both model-based and model-free techniques:

- Beaufort Assessment Model (age structured model)
- Total Mortality Estimation via Catch Curve Analysis and Mean Length Estimator
- Surplus Production Model (non-age structured model)

Means to understand the status of the cobia stock in Virginia are urgently needed to determine if the closure is necessary. Additional indices of stock status can be developed using max size, and provided to VMRC, SEDAR and other interested parties. A paucity of larger individuals in the catch is a red flag, suggesting the possibility of overfishing (Erisman et al., 2014). Therefore, we proposed to use existing data on max size to shed light on the status of cobia.

2 Objective

Use existing recreational catch records to evaluate change in maximum size of cobia over time, which is known to be a sensitive indicator of stock status. Cobia maximum size data will be used to develop several size-based stock indices using published methods. Sources of bias in the various data sources will be discussed with anglers who may have understanding of collection methods and other issues that are not evident to scientists. Data and indices will be provided to VMRC, SEDAR and other interested parties. Results will be provided within one year of the start of the project.

3 Expected Results and Benefits

Recreational anglers in Virginia will benefit from a more data-rich management process. This project is an opportunity for recreational anglers to participate directly in the science by providing data, and by providing important information necessary to interpret data in the most parsimonious manner. Fishery managers will benefit from the additional data and new stock indices. A strong decline in maximum size of cobia through time will indicate heavy fishing pressure, while a steady maximum size will indicate a healthy population. Results will be complementary to the assessments conducted by SEDAR.

4 Approach

4.1 Available data sources

The cobia fishery in Virginia, and in the other recreational fisheries of the Mid-Atlantic, may not provide size frequency data for the catch as a whole; but instead provide data on the largest

individuals (citations) or smaller individuals (tagging records). However, privately held records may include lengths of all individuals caught.

MRIP data: many records are based on visual estimates of size, rather than measurements, and are subject to error.

Charter captain records: while many charter captains have entered the fishery recently and thus would not have multi-year records, there are some captains who have been in the fishery more than a decade. If records include fish length or weight, these are likely to be the least biased records, in that all size classes captured are recorded.

Fishing club records: Some fishing clubs have monthly tournaments and other activities than may generate time series data. Such records are likely to bias towards large fish due to retention of only largest individuals.

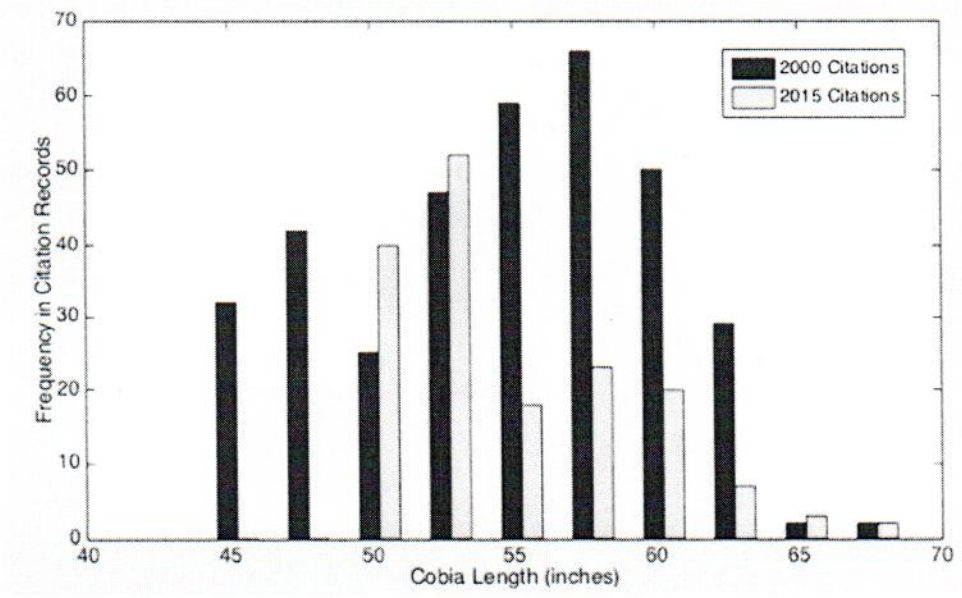
Citation records: knife-edge bias to larger fish resulting from length required to receive citation.

VIMS tagging program records: biased towards smaller fish due to non-tagging of large individuals (which are kept for consumption).

We prefer to use only data in which length was measured. In some cases, fish may be weight but not length measured. It is possible to convert weight to length:

$W = aFL^b$ where a=2.00E-09 and b=3.28, W=weight, FL=total length (SEDAR28 table 2.16)

however, major changes in girth occur pre- and post-spawn for females, meaning that such conversions are subject to error.



As an initial data exploration we plotted histograms of cobia size from the year 2000 and the year 2015. There are differences in the size frequency between the two years, suggesting that enough data may be available to reveal patterns through time. Note that there was a change in minimum size required for a citation between 2000 and 2015, so the 2015 data do not include the smallest size classes. Data source: VRMC.

4.2 Collaborating participants

One of our investigators (S. Musick) has a long history of working with Virginia anglers, charter captains and sport fishing clubs, and has already made contact with several key players in the recreational fishery.

The multiple Virginia Institute of Marine Science researchers submitting cobia research proposals in the June 2016 Virginia Saltwater Recreational Fishing Development Fund (VSRFDF) cycle will work cooperatively to capitalize on project dissemination, angler participation, and data and sample collection. The VIMS Marine Advisory Services Marine Recreation Specialist will serve as a central point of contact for stakeholders interested in the projects and coordinate information requests with each project's Principal Investigator.

Staff from the Virginia Institute of Marine Science will also work together to host a central, introductory stakeholder focus group workshop in early winter 2017. The workshop will be coordinated and facilitated by VIMS Marine Advisory Services' staff. The focus group will include cobia anglers, cobia charter captains, and top cobia taggers from the Virginia Game Fish Tagging Program. This workshop will provide an opportunity for all VIMS' staff working on VSRFDF projects to give an overview of their projects, data needs and field collection methods, and give an opportunity for anglers to give direct feedback. As many of the anglers in the stakeholder focus group will potentially be working on all of the projects, this workshop should also centralize outreach efforts and make it easier for anglers to contribute.

4.3 Analysis

Size data will be compiled from the above sources, and used to generate several indices of status based on published methods. Some indices will require only max reported size, others may require further data. Most published approaches that use maximum size require information on other aspects of the fishery, which may not be available in the case of the cobia.

It should be noted that we do not proposed to replace or compete with SEDAR in the assessment of this or any fish stock, but instead we aim to provide data and approaches to SEDAR, VMRC and other interested parties for consideration. The indices we propose to develop are applicable to data-limited fisheries such as cobia, and can be used to develop harvest control rules (Pazhayamadom et al., 2015). The specific indices we propose are as follows.

4.3.1 Temporal change in maximum length

The simplest indicator of fishing effects will be a temporal decline in reported maximum length. Because maximum observed length is highly dependent on sample size, upper quartiles are more robust, so we will plot L95%, the mean of the largest 5% of reports for the year (Shin et al., 2005). This index could be generated from citations, charter captain records, fishing club records (but not tagging records).

4.3.2 Large Fish Indicator

The Large Fish Indicator (Greenstreet et al., 2011) requires length frequency data for the entire fishery, ie. not only for large individuals. (LFI=proportion of individuals over X cm FL). Such an index could be calculated from the charter captain records, but not from other records due to strong size bias.

4.3.3 Samples to yield large individual (NZ50)

A recently developed index of stock status measures the rarity of large individuals in the catch. NZ50 is the least number of observations required of a random sample to include one or more individuals equal to or greater than a specified size in 50% of such samples (i.e., the smallest number of observations to include fish at least that big half the time) (Goodyear, 2015). NZ50 could be calculated from the charter captain records.

5 Location

The project will be carried out at the Virginia Institute of Marine Science. This is a data analysis project, and does not involve field work. We anticipate driving to meet with anglers throughout the State, as appropriate.

6 Estimated cost

Personnel: We request tuition and stipend for one VIMS graduate student (Crear), and one month of salary for one VIMS faculty member (Weng).

http://www.vims.edu/about/leadership/sponsored_programs/apply/rates/student.php

Travel: We request driving costs for meeting with anglers, attending club meetings, and other data discovery and networking activities.

Supplies: We request funds to purchase hats, Tshirts and stickers with a project logo to distribute to participating anglers; as well as funds for printing posters, flyers, and other outreach materials.

Equipment: None

Indirect cost rate: VMRC allowed rate is 25%. The federally negotiated Facilities and Administrative rate for the Virginia Institute of Marine Science is 45.7% of the modified total direct costs. The difference between the allowed rate and approved rate will be contributed as match.

7 Resumes

Kevin C Weng, PhD
Assistant Professor, Fisheries Science Department, Virginia Institute of Marine Science
College of William & Mary, 1375 Greate Road, Gloucester Point, Virginia 23062-1346 USA
(804) 684-7372 kevinweng@vims.edu fish.vims.edu

A. Professional Preparation
Williams College, Williamstown MA. Geology, BA, 1993
University of Hawaii at Manoa, Honolulu HI. Oceanography, MSc, 1999
Stanford University, Stanford CA. Biology, PhD, 2007

B. Appointments
2014-present: Assistant Professor, Virginia Institute of Marine Science
2009-2014: Program Manager, Pelagic Fisheries Research Program

2007-2008: SOEST Young Investigator, University of Hawaii
2000-2007: PhD Candidate, Stanford University
1996-1999: MSc Candidate, University of Hawaii
1994-1996: Environmental Consultant, ERM Hong Kong, Ltd.

C. Products

(i) Five most related publications (7 peer-reviewed in 2015, 29 total)

1. Weng, K. C., Pedersen, M. W., Del Raye, G., Caselle, J. E., and Gray, A. E., 2015, Umbrella species in marine systems: using the endangered humphead wrasse to conserve coral reefs: Endangered Species Research 27: 251–263
2. Pedersen, M. W., Burgess, G., Weng, K. C. (2014), A quantitative approach to static sensor network design. Methods in Ecology and Evolution. doi: 10.1111/2041-210X.12255
3. Weng, K. 2013. A pilot study of deepwater fish movement with respect to marine reserves. Animal Biotelemetry 1(17): 1-9
4. Pedersen, M, Weng, K, 2013. Estimating individual animal movement from presence-absence data. Methods in Ecology and Evolution 4(10): 920-929.
5. Stevenson, C, L Katz, F Micheli, B Block, K Heiman, C Perle, K Weng, R Dunbar and J Witting, 2007. High apex predator biomass on remote Pacific islands. Coral Reefs 26: 47-51 DOI 10.1007/s00338-006-0158-x

(ii) Five other publications

6. Comfort, C, Weng, K. 2015. Environmental drivers of vertical behavior of Hexanchus griseus in Hawaii. Deep Sea Research II 115:116-126
7. Weng, KC, PC Castilho, JM Morrissette, A Landiera, DB Holts, RJ Schallert, KJ Goldman and BA Block, 2005. Satellite tagging and cardiac physiology reveal niche expansion in salmon sharks. Science 310: 104-106
8. Weng, KC, D Foley, J Ganong, C Perle, G Shillinger, B Block 2008. Migration of a high trophic level predator, the salmon shark, between distant ecoregions. Marine Ecology Progress Series 372: 253–264
9. Del Raye, G and Weng, K. 2015. Using Aerobic Scope to Model Interacting Effects of Ocean Acidification, Warming, and Deoxygenation on Marine Fish. Deep Sea Research II. doi:10.1016/j.dsr2.2015.01.014
10. Block, BA, SLH Teo, A Walli, A Boustany, MJW Stokesbury, CJ Farwell, KC Weng, H Dewar, and TD Williams, 2005. Electronic tagging and population structure of Atlantic bluefin tuna. Nature 434: 1121-1127

D. Synergistic Activities

Diving safety officer hiring review panel, University of Hawaii, 2011
Instructor, National Geographic short course on marine animal tracking, Indonesia, 2015
Editorial Board, Animal Biotelemetry.
Co-Chair, Climate Impacts on Top Predators (CLIOTOP-GLOBEC/IMBER).
Organizer for conference: 3rd CLIOTOP Symposium, San Sebastian, Spain, 2015; 2nd CLIOTOP Conference, Noumea, New Caledonia, 2011; Pelagic Fisheries Research Program Meeting, Honolulu, 2009, 2010, 2011, 2012; International White Shark Symposium, February 2010, Honolulu.

Co-Chair of Electronic Tracking Session, ICES Annual Science Meeting, Halifax, Canada, September 2008.

E. Collaborators & Other Affiliations

Collaborators and co-editors: Arrizabalaga, Haritz (AZTI); Block, Barbara (Stanford University); Brill, Richard (NOAA / VIMS); Bruce, Barry (CSIRO); Burgess, Greg (U FL); Cailliet, Greg (MLML); Chapple, Taylor (Stanford University); Costa, Daniel (UCSC); Evans, Karen (CSIRO); Gasalla, Mary (U Sao Paulo); Hearn, Alex (Turtle Isl Res Net); Hilton, Eric (VIMS); Hobday, Alistair (CSIRO); Holland, Kim (University of Hawaii); Jorgensen, Salvador (Monterey Bay Aquarium / Stanford University); Karl, Stephen (U Hawaii); Lowe, Chris (CSULB); Lyons, Kady (CSULB); Maury, Olivier (IRD); Mollet, Henry (Mont Bay Aq); Neuheimer, Anna (Univ of Hawaii); Nicol, Simon (Sec Pacific Comm); Reeb, Carol (Stanford University); Scheld, Andrew (VIMS); Thys, Tierney (Sea Studios); Young, Jock (CSIRO).

Graduate Advisors and Postdoctoral Sponsors (2): PhD advisor: Barbara A Block (Stanford University). MSc advisor: John R Sibert (University of Hawaii). Post-doctoral sponsor: n/a.

Thesis Advisor and Postgraduate-Scholar Sponsor:
Postdoctoral (2): Timothy Sippel (U Hawaii), Martin Pedersen (University of Hawaii).
PhD (4): Gen Del Rey (U Hawaii), Eun Jung Kim (U Hawaii, co-advised), Stephen Scherrer (U Hawaii), Dan Crear (VIMS).
MSc (4): Christina Comfort (U Hawaii), Andrew Gray (U Hawaii), Gadea Perez-Andujar (U Hawaii), Greg Burgess (U Hawaii, co-advised).
Undergraduate (4): Michael Gray (U Hawaii), David Slater (U Hawaii), Danielle Garcia (U Hawaii), William Laney (College of William & Mary).

8 Literature Cited

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Ault, J.S., Smith, S.G., Bohnsack, J.A., 2005. Evaluation of average length as an estimator of exploitation status for the Florida coral-reef fish community. ICES J. Mar. Sci. 62, 417-423.

Ault, J.S., Smith, S.G., Browder, J.A., Nuttle, W., Franklin, E.C., Luo, J., DiNardoe, G.T., Bohnsack, J.A., 2014. Indicators for assessing the ecological dynamics and sustainability of southern Florida's coral reef and coastal fisheries. Ecological Indicators 44, 164-172.

Beldade, R., Holbrook, S.J., Schmitt, R.J., Planes, S., Malone, D., Bernardi, G., 2012. Larger female fish contribute disproportionately more to self-replenishment. Proceedings of the Royal Society B-Biological Sciences 279, 2116-2121.

Berkson, J., Thorson, J.T., 2015. The determination of data-poor catch limits in the United States: is there a better way? ICES J. Mar. Sci. 72, 237-242.

Brown-Peterson, N.J., Overstreet, R.M., Lotz, J.M., Franks, J.S., Burns, K.M., 2000. Reproductive biology of cobia, Rachycentron canadum, from coastal waters of the southern United States.

Butterworth, D., Cochrane, K., De Oliveira, J., 1997. Management procedures: a better way to manage fisheries? The South African experience. Global trends: fisheries management AFS Symposium 20, 83-90.

Darden, T.L., Walker, M.J., Brenkert, K., Yost, J.R., Denson, M.R., 2014. Population genetics of Cobia (Rachycentron canadum): implications for fishery management along the coast of the southeastern United States. Fish. Bull. 112, 24-35.

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56 Cedar Lane
Newport News, VA 23601

June 5, 2016

Dear Susanna,

I would like to participate in the project investigating the maximum size of cobia over time and the focus group meeting associated with the project in 2017.
I have extensive angling experience in Virginia, and over 12 years recreational fishing targeting cobia. I have participated in the Virginia Game Fish Tagging Program for several years and tagged more than 800 fish in the program.
If you have any questions or concerns please do not hesitate to contact me.

Thank you,

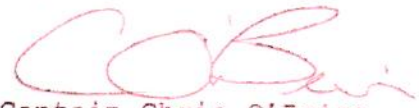
Wes Blow

June 2, 2016

Re: Cobia Proposal(s) Letter of Support

Submitting this letter to confirm support in the cobia proposal(s) being generated for future research in the cobia fishery.

Regards,



Captain Chris O'Brien
Hydrologic Sportfishing
Norfolk, VA
301-266-0808
www.hydrologicsportfishing.com

1806 Rosemont Lane
Hayes, VA 23072

June 3, 2016

Dear Susanna,

I am interested in participating in the project researching the maximum size of cobia over time and contributing catch data for the project. I am also interested in participating in the focus group meeting associated with the project in 2017.
I have extensive angling experience in Virginia, and over 10 years recreational fishing for cobia. I have also joined the Virginia Game Fish Tagging Program and contributed to focus groups for other research units at the Virginia Institute of Marine Science.
If you have any questions please feel free to contact me.

Thank you,

John Corbett
boatcaptjohn@gmail.com