



ROY COOPER
Governor

MICHAEL S. REGAN
Secretary

BRAXTON C. DAVIS
Director

December 21, 2017

TGS-NOPEC
c/o Gabriel Rolland
10451 Clay Road
Houston, TX 77043

Dear Mr. Rolland:

The North Carolina Division of Coastal Management (DCM), on behalf of the State of North Carolina and its Coastal Zone Management Program, hereby requests that you submit a supplemental consistency certification in accordance with 15 CFR 930.66. This request is based on significant new circumstances and information detailed below and relevant to the Geological and Geophysical (G&G) survey activities you proposed and that DCM found conditionally consistent with the State's enforceable coastal policies in 2015.

Consistency Determination History

In the summer of 2014, the State of North Carolina received notice that nine applications to conduct G&G activities off the North Carolina coast had been submitted to the U.S. Bureau of Ocean Energy Management (BOEM), including your company's request. On August 20, 2014, the State requested approval under the Federal Consistency provisions of the federal Coastal Zone Management Act (CZMA) to review the proposed activities contained in these nine applications, asserting that the proposed activities could have reasonably foreseeable coastal effects on the State's coastal resources or uses. On November 18, 2014, the National Oceanic and Atmospheric Administration's Office for Coastal Management (NOAA OCM) approved the State's request to review your application for consistency with the enforceable policies of the State's Coastal Management Program, determining that the proposed activities, if permitted, could have reasonably foreseeable effects on coastal uses or resources of North Carolina's coastal zone. NOAA OCM's approval pertained primarily to any potential impacts on commercial and recreational fisheries, including potential user conflicts and catch reductions, and consequential economic impacts.

On March 19, 2015, the State received your consistency submission to conduct two-dimensional (2D) marine G&G surveys in the Atlantic Ocean off the North Carolina coast related to oil and gas resource development. To better understand the possible concerns, the State solicited input from the public and State agencies that have regulatory and resource management interests, and held a public hearing on April 9, 2015 in Morehead City, North Carolina. Numerous comments were received during the hearing concerning the potential impacts of seismic surveys on marine organisms and habitats, including the possibility of cumulative impacts to marine ecosystems and the fisheries they support.

On June 16, 2015, the State found your proposed activity conditionally consistent with the relevant enforceable policies of North Carolina's Coastal Management Program. This determination was based upon our review of the currently available data and literature on the potential impacts of 2D seismic surveys on marine organisms and habitats.

Legal Process when New Information is Learned

Since 2015, the State has become aware of new information and studies published regarding the potential impacts of G&G activities on marine resources, as detailed below. Based on this new information, the State believes that the reasonably foreseeable coastal effects of your proposed G&G survey activities on the State's coastal resources and uses are substantially different than those originally described in your March 19, 2015 consistency certification, and that your proposed activities are therefore subject to supplemental coordination in accordance with 15 CFR 930.66.

Federal regulations require that "applicants shall further coordinate with the State agency and prepare a supplemental consistency certification if the proposed activity will affect any coastal use or resource substantially different than originally described." 15 CFR 930.66(a). The regulations state that substantially different coastal effects are reasonably foreseeable if "(2) There are significant new circumstances or information relevant to the proposed activity and the proposed activity's effect on any coastal use or resource." 15 CFR 930.66(a). Based on the new studies described below, the State believes that the activity you have proposed will have coastal effects substantially different than originally described, and may severely impact the biological, social, and economic value of North Carolina's commercial and recreational fisheries which would be in conflict with North Carolina's approved coastal management program, specifically 15A NCAC 07H and 15A NCAC 07M. The State therefore requests that you submit a supplementary consistency certification in accordance with 15 CFR 930.66.

New Research and Substantially Different Effects on Marine Fisheries

The Atlantic Programmatic Environmental Impact Statement (PEIS) reports impacts to fish ranging from mortality to injury to behavioral responses. Section 4.2 and Appendix J of the Programmatic EIS describe the relevant research regarding effects of airguns on fish and note that there has been limited research on these topics that makes drawing conclusions of any type of effect on fish populations problematic. According to Appendix J of the Programmatic EIS, sound plays a major role in the lives of all fishes, as it is attenuated at a much lower rate than other forms of energy, such as light. The lower frequencies of sound are important for communication and environmental sensing. Using sound, fish can obtain a great deal of biotic (living) and abiotic (environmental) information, important for the detection of a reef or swimming predators. Bony fishes use sound for a wide range of behaviors including communication, mating, and territorial interactions. Sound produced from anthropogenic sources, such as the array of airguns used in the proposed survey activities, can impede the ability of fishes to hear biologically relevant sounds, a phenomenon known as "masking." Anthropogenic sound can also have a direct impact on the catchability of fishes by altering normal behaviors, and possibly affecting the survival of individuals or populations.

Anthropogenic sound effects on fish, specifically from seismic surveys, can be described as physiological and behavioral. The most critical issue regarding the effect of anthropogenic sound on fishes is behavioral and thus can impact catchability by potentially impacting fish over a broad area, impeding their ability to interpret and produce biologically relevant sounds. While a limited number of well-controlled studies on the effects of sound on fishes and fish species exist, it has been demonstrated both nationally and internationally that loud intermittent sounds have the potential to cause physiological injury or death if the animal is located close to the source. These sounds can also result

in hearing impairment, masking, and behavioral effects at distances beyond those that would result in death or injury.

Interim criteria for regulatory levels of sound arose on the U.S. West Coast out of concern about effects of pile driving activities on fish. The current interim criteria established a peak sound level of 206-dB and a sustained exposure level of 187-dB for individual fishes weighing more than two grams, or 183-dB for fishes below two grams. These criteria are for the onset of easily identifiable physiological effects, rather than behavioral effects which occur at a much lower sound levels and are much harder to identify. The sound levels released from the arrays of the proposed projects are expected to exceed these levels. The sound levels at the sea floor may be somewhat less due to some loss with propagation distance. The Programmatic EIS summarizes the radial distances in meters to the 160-dB and 180-dB received sound pressure level from a single pulse of a 2D airgun array (Programmatic EIS Table 4-8). The 180-dB radius ranges from 799 to 2,109 meters (0.5-1.1 nmi) and the 160-dB radius ranges from 5,184 to 15,305 meters (2.8-8.3 nmi). It should be noted that the threshold for Level B behavioral harassment on marine mammals is set at 160-dB; depending on water depth, this sound pressure level could be received by animals over 15,305 meters or 8 nautical miles from the source.

While the potential for physiological damage is lowered by fishes' ability to move away from the high intensity seismic sound, behavioral studies have shown reduced catch rates lasting for several days after the termination of airgun use. The decline in catch rates was assumed to be from fish moving away from the fishing site, and either moving into deeper water or being killed. A new study, published earlier this year (Paxton *et al.* 2017) and specific to North Carolina, demonstrated a 78 percent decline in snapper grouper complex species abundance during evening hours at a reef habitat site off the central North Carolina coast after seismic testing occurred. During the three days prior to survey activity, fish habitat use was highest during those same hours based on analysis of video data. It is important to note that this site was not directly in line with the survey track, and of the three sites in the study, was in fact the farthest away (7.9 km) from the survey track. Researchers also deployed hydrophones at the reef sites and noted that while noise levels exceeded 170 dB re 1 μ Pa, the peak levels were unknown as the noise levels overloaded the instruments. Both spherical and cylindrical spreading models were used to estimate peak noise levels at the sites closest to the survey track based on a sound source level of 258.6 dB re 1 μ Pa. Model results indicated the received sound levels ranged from 202-230 dB re 1 μ Pa.

While the Paxton *et al.* study was limited, the resultant reduction in abundance occurring from a single seismic survey is cause for concern given the multiple overlapping proposed surveys and the extended timeframes over which they would occur. As noted above, such significant decreases in abundance can lead to reduced catch rates, especially during peak seasons for commercial and recreational fisheries, and will have a large impact on coastal communities that are dependent on the 22,500 jobs, \$787 million in income, and \$1.96 billion in business sales annually generated by these industries. Seismic surveys occurring during October through December have the greatest potential to impact commercial fisheries, as these months represent the peak of commercial harvest, while surveys occurring from May through October have the most potential to impact recreational fisheries.

Other issues of concern regarding the effects of anthropogenic sound on the catchability of fish include increased production of stress hormones in fish, impacts on invertebrates, and impacts from vessel noise. A study of Atlantic salmon that were subjected to up to 10 simulated seismic airgun explosions showed that exposure caused the release of primary stress hormones, adrenaline and cortisol, as a physiological and biochemical response. Even though the study recorded no mortalities and that fish returned to normal levels after 72 hours, the temporal impact of stress from seismic sound could affect catchability. Carroll *et al.* (2017) summarized documented effects to different life stages of fish to low-frequency seismic sounds. More studies have found physical, behavioral, and physiological responses

from juvenile and adult fish than from eggs and larvae, although there have been fewer studies looking at these early life stages.

Limited information and data exists on the hearing of aquatic invertebrates and the impacts from high intensity sound. It is thought that the chance of physiological damage is lowered due to the lack of resonating sound structures in invertebrates, normally damaged by high intensity sounds. However, a recently published study (McCauley *et al.* 2017) designed to investigate the impacts of a single airgun (similar to those used in commercial arrays) on the local zooplankton field demonstrated significant differences in both zooplankton abundance and mortality after airgun exposure. Comparison of control and exposed tows showed a greater than a 50 percent decrease in abundance in 58 percent of all individual zooplankton taxa. The distribution of abundance decreases between exposed and control tows for all taxa showed a median decrease in abundance of 64 percent. Additionally, comparison of control tows (e.g., those occurring prior to airgun blasts) between day 1 and day 2 of the study demonstrated a decrease in mean and median zooplankton abundance of 89 percent and 96 percent, respectively. Assessment of mortalities from each day of the study showed two- to three-fold increases across all taxa as compared to controls. Finally, impact ranges (i.e., the distances at which no impact versus varying degrees of impact would be expected) were calculated for both abundance and mortality, and were found to be more than two orders of magnitude greater than previously assumed. The results of this study raise additional concerns regarding effects on fish eggs and larvae, given similar size ranges as the zooplankton in the above experiments, as well as potentially cascading impacts to the base of the food chain. It should be noted that larval fish are also briefly part of the zooplankton community. Both juveniles and species that are forage for higher tropic level fishes depend on zooplankton for their dietary needs.

Additional field studies on bivalve molluscs and crustaceans have determined varying physiological and behavioral impacts of repeated exposure to seismic air gun signals. Day *et al.* (2017) demonstrated significant increases in mortality of scallops, as well as changes in behavioral patterns and consistent disruption of hemolymph (blood analog) chemistry, resulting in potential immunodeficiency. Fitzgibbon *et al.* (2017) also found significant changes to hemolymph cell counts in spiny lobsters subjected to repeated air gun signals up to a year post-exposure, suggesting compromised immunological capacity. The results of these studies have biological and economic implications for North Carolina's molluscan bivalve and crustacean fisheries. Bivalves such as clams and scallops are particularly vulnerable to the effects of repeated exposure due to their sessile nature, while the state's hard blue crab fishery is the highest revenue-generating fishery, consistently grossing over \$20 million in ex-vessel value over the past five years.

The potential effects described above were not available for reference at the time that your certification was reviewed for consistency with the state Coastal Management Program. This new information was important in the finding that the reasonably-foreseeable coastal effects of your proposed survey will be substantially different than originally described. The recently-published research cited above shows that sound produced from the proposed G&G survey activities has a direct impact on fishes by masking biologically relevant sounds and altering normal behaviors, and can possibly affect the survival of individuals or populations. Sound-related disturbances in areas of concentrated fish and sensitive fish habitat could impact local fish abundance by deterring foraging, refuge, and spawning activities. The resultant displacement of fish could change distributions of fish in the water column, reduce catches, and affect economically valuable fisheries and operations throughout the regional survey area. Additionally, changes in zooplankton abundance could result in cascading impacts on various tropic levels within the food chain.

Importance of North Carolina's Commercial and Recreational Fisheries

North Carolina's coastal areas support industries vital to the State's economy, including the commercial and recreational fishing industries. According to the Atlantic PEIS, the Wanchese-Stumpy Point port is ranked 55th in the nation for commercial fishing revenues. North Carolina also has 26 of the 108 fishing communities identified by the National Marine Fisheries Service (NMFS), the largest concentration from Delaware to Florida. With approximately 2,973 active commercial fishermen and 575 seafood dealers in 2016, the commercial fishing industry supported an estimated 7,410 jobs, \$166 million in income, and \$388 million in business sales in 2017 (NCDMF 2017). In 2016, approximately 1.8 million recreational anglers also took over 5.4 million fishing trips in North Carolina's coastal waters (NCDMF 2017). The Atlantic PEIS ranks North Carolina as fifth in the nation for the total expenditures and durable goods expenditures related to recreational fishing and second in total number of saltwater angler trips occurring from Delaware to Florida. This coastal recreational fishing activity supported an estimated 15,069 jobs, \$621 million in income, and \$1.57 billion in business sales in the State economy (NCDMF 2017). When commercial and recreational fishing activities are combined, the coastal fishing industry in North Carolina is estimated to support approximately 22,500 jobs, \$787 million in income, and \$1.96 billion in business sales annually, with much of this economic activity occurring in counties having limited alternatives for employment or revenue.

Most commercial landings and value from the ocean are from otter trawls, longlines, hook-and-line, and gillnets. In 2016, Atlantic croaker, spiny dogfish, summer flounder, snapper-grouper complex species, bluefish, sharks, tunas, coastal migratory pelagic species (king mackerel, Spanish mackerel, cobia, dolphin and wahoo), shrimp (brown, pink, white), and kingfishes comprised 91 percent of the landings and 89 percent of the value for fish landed from the ocean. From 2012 to 2016, commercial fisherman landed an average of 58,947,596 pounds of seafood with an average annual ex-vessel value of \$86,908,169 from North Carolina's waters. Approximately 31 percent of the average annual commercial landings and 33 percent of the value could be attributed to commercial landings from State and federal ocean waters. Although almost half of the commercial landings (48 percent) occurred in State ocean waters, most of the value (73 percent) was from fisheries that occurred in federal waters (greater than three miles from shore). On average, a total of 9.4 million pounds of seafood valued at \$21 million were landed in North Carolina from federal waters.

Extremely low allowable regional catch levels for some snapper-grouper species constrain harvests to quantities that may appear relatively minor, but provide significant economic benefit to individual fishery participants as well as communities. For example, North Carolina trip ticket data show that in 2016 the months of October, November, and December account for the highest landings value of seafood, \$13.4 million dollars, from State and federal ocean waters. Over 85 percent of the value came from four species groups (shrimp, snapper-grouper complex, summer flounder, and coastal migratory pelagics). In particular, species from the snapper-grouper complex landed in these months had a total estimated ex-vessel value of \$615,902 from 184,874 pounds; comparatively Atlantic croaker had a total estimated ex-vessel value of \$448,381 from 411,749 pounds. Therefore, harvest from several of these offshore fisheries catches has a relatively small weight but a high value per pound, increasing the economic impact to these fisheries should they be impeded by seismic survey activities.

On average from 2012 to 2016, a total of 3,081,479 recreational trips occurred in ocean waters off North Carolina. Over 2 million of those trips were from nearshore ocean waters (less than three nautical miles), and 9 percent were from waters greater than 3 miles from shore. Average annual recreational landings from the ocean were almost 9 million pounds for the years 2012-2016. Approximately 37 percent of recreational ocean landings were from for-hire boats fishing in waters greater than three miles offshore, with peak activity occurring from May to October. May through October are also popular months for diving and spearfishing, with much of this activity occurring greater than three

miles offshore. During peak times, species in the coastal migratory pelagics and snapper-grouper complex are the most targeted by ocean anglers, as evidenced by the many recreational and charter boat trips, as well as tournaments targeting these species. These species include white marlin, blue marlin, sailfish, yellowfin tuna, dolphin, wahoo, Spanish mackerel, bluefish, king mackerel, black sea bass, greater amberjack, and red porgy.

Several areas in the regional grid for the proposed survey activity are identified as Essential Fish Habitat (EFH) and a subset of these are Habitat Areas of Particular Concern (HAPC). These areas experience annual closures affecting commercial and recreational fishermen. Area closures to gear and species, such as the Mid-Atlantic bottom longline closure and shallow water grouper spawning season closure, are in place to protect certain species from harvest during spawning periods in these EFH and HAPC areas. The commercial Mid-Atlantic bottom longline closure (January 1 to July 31) was established for the protection of the sandbar and dusky shark nursery and pupping areas, and covers a large portion of the regional grid starting at the shoreline and extending to the 55-fathom mark, below Oregon Inlet to the Cape Fear River (Programmatic EIS Figure 4-23). This closure also limits the catch of demersal (bottom-dwelling) species to five percent of the total catch composition. Similarly, the shallow water grouper closure (recreational and commercial) from January 1 to April 30, prevents the harvest of gag, scamp, black grouper, red grouper, coney, graysby, red hind, rock hind, yellowmouth grouper, and yellowfin grouper during their spawning season. This closure applies to all State and federal waters.

Additionally, offshore natural habitats and the 42 artificial reefs off North Carolina's coast are used for both recreational and commercial fishing, with as many as 45 fishing tournaments occurring annually. Specific areas of recreational and commercial fishing interest to North Carolina fishermen include, but are not limited to: The Point; Ten Fathom Ledge; Big Rock; and the shoals of Cape Lookout, Cape Fear, and Cape Hatteras. These offshore natural and artificial habitats are also popular diving and spearfishing sites, with much of the activity occurring more than three miles offshore. Many of these offshore areas, such as The Point, experience year-round, heavy use by all user groups.

Conclusion

The new information now available to the State raises additional, different, and significant concerns regarding harms to the State's resources that may be caused by your proposed G&G seismic surveys. Your review of this new information through a supplemental consistency determination will be important in the State's determination of whether your proposal continues to be consistent with North Carolina's enforceable coastal policies. For these reasons, the State of North Carolina requests supplemental coordination pursuant to 15 CFR 930.66.

Sincerely,



Braxton Davis

Director, N.C. Division of Coastal Management and N.C. Division of Marine Fisheries

Cc: Michael Regan, Secretary, N.C. Department of Environmental Quality

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Literature Cited

- Carroll, A.G., R. Przeslawski, A. Duncan, M. Gunning, and B. Bruce. 2017. A critical review of the potential impacts of marine seismic surveys on fish and invertebrates. *Marine Pollution Bulletin* 114: 9-24.
- Day R.D., R.D. McCauley, Q. P. Fitzgibbon, K. Hartmann, and J.M. Semmens. Exposure to seismic air gun signals causes physiological harm and alters behavior in the scallop *Pecten fumatus*. *PNAS* 2017 114 (40) E8537-E8546; published ahead of print September 18, 2017, doi:10.1073/pnas.1700564114
- Fitzgibbon, Q. P., R.D. Day, R.D. McCauley, C.J. Simon, and J.M. Semmens, J. M. 2017. The impact of seismic air gun exposure on the haemolymph physiology and nutritional condition of spiny lobster, *Jasus edwardsii*. *Marine Pollution Bulletin* 125: 146-156. <http://dx.doi.org/10.1016/j.marpolbul.2017.08.004>
- McCauley, R.D., R.D. Day, K.M. Swadling, Q.P. Fitzgibbon, R.A. Watson and J.M. Semmens. 2017. Widely used marine seismic survey air gun operations negatively impact zooplankton. *Nature Ecology & Evolution* 1: 0195. Doi: 10.1038/s41559-017-0195.
- NCDMF (North Carolina Division of Marine Fisheries). Commercial Trip Ticket Program, License and Statistics Section. Accessed July 2017.
- NCDMF (North Carolina Division of Marine Fisheries). Coastal Angling Program, License and Statistics Section. Accessed July 2017.
- NCDMF (North Carolina Division of Marine Fisheries). Fisheries Economics Program, License and Statistics Section. Accessed July 2017.
- Paxton, A.B., J.C. Taylor, D.P. Nowacek, J. Dale, E. Cole, C.M. Voss and C.H. Peterson. 2017. Seismic survey noise disrupted fish use of a temperate reef. *Marine Policy* 78: 68-73. <http://dx.doi.org/10.1016/j.marpol.2016.12.017>.