

February 1, 2012

Mr. Jim Kellogg, President
California Fish and Game Commission
1416 Ninth Street, Suite 1320
Sacramento, CA 95814

Dear Mr. Kellogg:

I prepared this letter at the request of the Coalition for a Sustainable Delta. This letter is to describe my findings regarding the potential economic impacts resulting from increased harvest of striped bass in the Sacramento-San Joaquin Delta associated with the regulatory proposal made by the Department of Fish and Game in collaboration with the National Marine Fisheries Service and U.S. Fish and Wildlife Service. While the magnitude of the major effects of this regulation is uncertain, economic models of fisheries offer insight into the likely impacts of this important change in regulation.

1. Overview

The increased harvest of striped bass (*Morone saxatilis*) has been proposed to reduce striped bass predation on endangered and threatened species in the anadromous waters of California. Striped bass prey on a wide variety of fish, including the Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, coho salmon, Central Valley steelhead, delta smelt, longfin smelt, and tidewater goby (hereafter “listed species”). These species, which are impacted by multiple stressors in addition to but including competition from and predation by striped bass, are all listed as “endangered” or “threatened” under either or both the federal Endangered Species Act¹ and the California Endangered Species Act.²

The proposed striped bass sport fishing regulation amendment proposal seeks to increase the abundance of the listed species through sport fishing regulations that would allow increased harvest of striped bass designed to reduce the abundance of striped bass (CDFG, 2011).³ The Department of Fish and Game has recommended the following provisions:

- Raise the daily bag limit for striped bass from 2 to 6 fish;

¹ Title 16, U.S.C., § 1531, et seq.

² Fish & G. Code, § 2050, et seq.

³ California Department of Fish and Game. 2011. “Report and Recommendation to the Fish and Game Commission in Support of a Proposal to Revise Sportfishing Regulations for Striped Bass.”

- Raise the possession limit for striped bass from 2 to 12 fish;
- Lower the minimum size for striped bass from 18 to 12 inches;
- Establish a "hot spot" for striped bass fishing at Clifton Court Forebay and specified adjacent waterways at which the daily bag limit will be 20 fish, the possession limit will be 40 fish, there will be no size limit, and anglers fishing at the hot spot will be required to fill out a report card;
- Changes to the sport fishing regulations for the Carmel, Pajaro, and Salinas Rivers to allow harvest of striped bass when the fishery would otherwise be closed.

The proposal allows for adoptive management based on actual conditions, with monitoring provisions for the striped bass population, the striped bass fishery, and the demographics of listed species.

Given uncertainty as to the ultimate effectiveness of the proposed regulation change, further changes to the regulation due to adoptive management provisions are not considered as an economic impact in this letter. Striped bass are extremely fecund with a long reproductive lifespan, making this anadromous species fairly resilient, and the hook and line gear used by sport fishers carries a relatively low risk of bycatch of listed species.

2. Economic Analysis

Recreational fishing is an important industry in California. In the Delta alone, it is estimated that anglers spend a total of 11.8 million person days (one person fishing one day) per year engaged in recreational fishing.⁴ In terms of economic value, annual expenditures of \$186 million among anglers in the Delta generate \$336 million in total output, \$138 million in income, \$209 in value-added and 6,152 jobs for the regional economy.⁵

Striped bass is a popular recreational fishery in California. Each year, hundreds of thousands of anglers fish for striped bass along shorelines and in boats in the Delta and in Commercial Passenger Fishing Vessels ("party boats") in the San Francisco Estuary. These anglers exert substantial fishing effort for striped bass. On average, anglers on Commercial Passenger Fishing Vessels in the San Francisco Estuary fished for striped bass 51,355 hours annually over the period 1980-2010, while anglers from Carquinez Strait to the base of dams in the Sacramento River watershed fished 1,073,790 hours annually during the periods 1998-2000 and 2008-2010 (CDFG, 2011).

The economic effect of the policy is driven to a large degree by population dynamics, both for the striped bass fishery and for the listed species. For this reason the ultimate effect of the policy on the striped bass fishery is difficult to forecast due to lack of resolution on stock-recruitment relationships following recent changes in diverted water flows (stripers depend on swift currents for spawning success) and the movement away from augmentation with hatchery-reared fish in the year 2000. The increasing trend in stocks over the 1994-2000 is likely attributable in large

⁴ Goldman, S., B. McWilliams, V. Pradhan and C. Brown. 1998. "The Economic Impact of Recreational Boating and Fishing in the Delta," Delta Protection Commission. Available at: http://www.delta.ca.gov/rec_economic.htm

⁵ *Supra* note 4.

part to augmentation with hatchery-reared fish (Kohlhorst 1999),⁶ and the subsequent decline in abundance of adult striped bass, which may be as low as roughly 500,000 after a recent peak of approximately 1,500,000 in the year 2000 (CDFG, 2011), may reflect a transition in the fishery stock as a result of unwinding this earlier trend. Summer and fall seasonal abundance of juvenile striped bass in the Bay-Delta region has remained low since the mid-1990s (CDFG, 2010).⁷

The economic implications of the proposed amendments on the striped bass sport fishing industry can be classified in terms of short-run and long-run benefits and costs. A good way to understand the distinction between short-run and long-run economic effects is to consider the catch-per-unit-effort (CPUE) relationship in the California striped bass sport fishing industry. CPUE represents the harvest in a fishery divided by a measure of the amount of effort expended by members of the industry to catch fish, and CPUE is commonly used as a measure of abundance (with greater catch per unit of effort representing greater abundance).

In the case of the California striped bass fishery, CPUE is commonly measured in terms of fish kept per 100 hours spent fishing (CDFG, 2011). The striped bass fishing industry is divided into two market segments represented by anglers on Commercial Passenger Fishing Vessels (CPFVs) in the San Francisco Estuary and anglers on docks, boats, and shorelines from Carquinez Strait to the base of dams in the Sacramento River watershed. In the CPFV market segment, anglers on CPFVs inside the San Francisco Estuary fished for striped bass an average of 51,355 hours and kept an average of 5,079 striped bass each year over the period 1980-2010, implying an average CPUE of 9.89 ($=5,079/513.55$) over the period (CDFG, 2011). In the Sacramento River market segment, anglers from Carquinez Strait to the base of dams in the Sacramento River watershed fished an average of 1,073,790 hours and kept an average of 57,217 striped bass each year over the periods 1998-2000 and 2008-2010, implying an average CPUE of 5.33 ($=57,217/10,737.9$) over the combined periods.⁸

Catch-and-release of striped bass, which has been promoted by the Department of Fish and Game, has the potential to alter CPUE in the fishery as a result of combined changes in regulation and in cultural practice. Anglers on CPFVs inside the San Francisco Estuary have released an average of 2,580 striped bass annually from 1995-2010, and anglers fishing from Carquinez Strait to the base of dams in the Sacramento River watershed released an average of 257,357 fish annually during the periods 1998-2000 and 2008-2010 (CDFG, 2011). Thus, while kept fish represent 66 percent of the total catch among anglers on CPFVs, kept fish represent only an 18 percent share of the total catch among anglers in the Sacramento River watershed, with the remainder representing catch-and-release. Thus, CPUE in the striped bass fishery can rise in the short-run without a physical change in the effort level of anglers following policy changes that redistribute the gross catch between kept fish and catch-and-release components of the industry, particularly in the case of anglers in the Sacramento River watershed.

⁶ Kohlhorst, D.W. 1999. "Status of Striped Bass in the Sacramento-San Joaquin Estuary," California Fish and Game 85(1): 31-36.

⁷ CDFG, Grant F-123-R-1. 2010. Inland and Anadromous Sport Fish Management and Research, Annual Progress Report, July 1, 2009 – June 30, 2010.

⁸ CPUE for anglers in the Sacramento River market segment are lower than in the CPFV market segment in part because anglers in the Sacramento River watershed may target other species besides striped bass, leading to greater released fish.

Overall, economic value is generated by the proposed regulations through changes in CPUE that provide direct benefits (costs) to anglers as CPUE increases (decreases) and through changes in the overall level of effort exerted by anglers in the fishery. An increase in fishing effort that raises the total annual expenditure level of anglers provides indirect and induced economic benefits (the so-called “multiplier effects”) in the regional economy.

2.1. Short-Run Analysis of the Proposed Amendments

In the short-run, the Department of Fish and Game recommendations are likely to provide considerable economic benefits to the California striped bass industry. At current levels of effort among anglers for striped bass (hours per year spent fishing), both changes in the bag and possession limits and the decline in minimum size from 18 to 12 inches are likely to shift a potentially large share of the catch-and-release component of the striped bass fishery to kept fish. Because juvenile striped bass are in greater abundance than adult striped bass, it is likely that most released fish were sub-adults (CDFG, 2011). Consequently, lowering the minimum size for striped bass is expected to lead to increased harvest of striped bass in the short-run for a given level of effort. Increasing the daily bag and possession limits for striped bass is similarly expected to increase the harvest of striped bass in the short-run for a given level of effort.

The economic implications of the proposed changes in minimum size requirements differs from the effect of changes in bag and possession limits according to differences in the resulting cohort structure of the population. Striped bass typically grow to a length of 12 inches in one year, and eat mostly zooplankton in their first year of life; however, as striped bass age, their diet includes increasing fractions of fish and invertebrates (Loboschefskey et al., 2011).⁹ For this reason, the proposed decrease in minimum size requirements from 18 to 12 inches serves to selectively harvest striped bass at precisely the age in which predation of listed species is likely to occur.

The short-run economic implications of the proposed amendments can be summarized as follows. First, CPUE in the striped bass fishery is likely to rise without additional inputs of effort by anglers due to the conversion of released fish to kept fish through the increase in bag and possession limits and decrease in minimum size requirements. The increase in CPUE for a given level of effort provides a short-run benefit to anglers without any additional cost. Second, the increase in CPUE in the short-run is likely to increase the effort anglers spend fishing for striped bass. The increased effort is likely to lead to increased permit sales and increased spending at local businesses in the short-run as anglers perceive a greater return to time spent fishing under the greater bag and possession limits.

2.2. Long-Run Analysis of the Proposed Amendments

In the long-run, the economic implications to the California striped bass industry are driven by changes in the CPUE that are determined by the decrease in striped bass abundance as harvest rates increase. Short-run increases in CPUE that are driven by changes in striped bass sport

⁹ Loboschefskey, E., G. Benigno, T. Sommer, T. Ginn, A. Massoudieh, K. Rose and F. Loge. 2011. Individual-level and Population-level Historical Prey Demand of San Francisco Estuary Striped Bass using a Bioenergetics Model.

fishing regulations are likely to be unsustainable in the long-run, as increasing the share of harvested fish from a given level of effort must ultimately reduce the breeding population of the fishery. Assuming population dynamics in the striped bass fishery are characterized by a transition to a biological equilibrium with reduced striped bass abundance, the proposed amendments are expected to lead to a decrease in CPUE over some period of time.

The long-run economic implications of the proposed amendments can be summarized as follows. First, increased annual harvest of striped bass in the short-run (a period of at least several years) is ultimately expected to lead to a decrease in CPUE in the long-run. The number of kept fish per year can rise or fall in the long-run depending on whether the stock of striped bass currently exceeds the level associated with the maximum sustainable yield. The long-run decline in CPUE in the striped bass fishery is expected to reduce economic values to anglers in the region, although the magnitude of the economic loss, which depends on the magnitude of the effect of the proposed regulation on the striped bass population, is unclear.

Second, in light of recent evidence that suggests fishing effort for striped bass depends on striped bass abundance (DuBois 2009),¹⁰ the amount of fishing effort (hours spent fishing per year) is likely to decrease in the long-run, particularly in the market segments explicitly targeting striped bass. To the extent that total fishing effort declines in the long-run as a result of the proposed regulation, economic values can be expected to decline in the region through a decrease in indirect and induced benefits (i.e., “multiplier effects”) in the regional economy from a reduction in annual fishing expenditures.

It is also important to consider the impacts of the proposal with respect to other species. For example, anglers may seek substitutes (e.g., black bass) or abandon fishing in favor of other recreational activities. In addition, greater sport and commercial harvest of salmon may offset the economic effects reduced striped bass angling. These effects may more than offset the effects of reduced striped bass stock over the long-term, although there is insufficient data to inform a rigorous analysis in support of this possibility.

2.3. The Discounting of Future Harvests

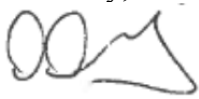
The present value of economic benefits and costs of the proposed regulation depends on the distribution of benefits and costs over time as well as on the discount rate used to convert future values into present value terms. The proposed striped bass regulation is expected to produce economic benefits in the short-run that are offset to some extent by economic losses in the long-run. The anticipated impact of greater striped bass harvests and greater fishing effort under the proposed amendments will provide positive direct, indirect and induced economic benefits to the regional economy over a period of at least several years, and these benefits arrive at an earlier time, and are therefore more valuable in present value terms, than the long-run economic losses that may be driven by reduced abundance of striped bass. Moreover, it is also worth noting that there is a greater degree of uncertainty regarding the long-run economic consequences of the proposed regulation due to difficulties in forecasting how the proposed regulation would impact the striped bass population and fishery in the long run.

¹⁰ DuBois, J. 2009. Factors affecting harvest and fishing effort in the anadromous striped bass fishery of California. California Department of Fish and Game. Stockton, CA.

3. Conclusions

The proposed change in regulation increasing the allowable catch of striped bass is likely to have substantial economic impacts in the short- and long-run. The Commission should consider these social impacts when acting on the proposal. The environmental review process mandated by the California Environmental Quality Act provides the Commission an opportunity to analyze these economic impacts in order to make an informed decision regarding the Department's regulatory proposal.

Sincerely,

A handwritten signature in black ink, appearing to read "DSunding", written over a horizontal line.

David Sunding
Professor, UC Berkeley
Principal, *The Brattle Group*