### **GOA Skates 2023 Risk Table-Ecosystem Considerations**

The most recent data available suggest an ecosystem risk Level 1 – Normal: “No apparent environmental/ecosystem concerns” given moderate environmental conditions, limited and mixed information on the abundance of prey, predators, and competitors, and a lack of a mechanistic understanding for the direct and indirect effects of environmental change on the survival and productivity of skates. The Skate complex is dominated in biomass by the big skate (Beringraja binoculata) and longnose skate (Raja rhina), and also includes the Aleutian skate, Bathyraja aleutica, the Bering skate, B. interrupta, and the Alaska skate, B. parmifera). This summary of environmental considerations for the Skates complex is based on big skate, a representative of the dominant species retained catch by biomass, and the minor species of skates (the Aleutian skate, *Bathyraja aleutica*, the Bering skate, *B. interrupta*, and the Alaska skate, *B. parmifera*).

**Environment**: While optimal temperatures for skate life stages (all demersal) are not known, it is reasonable to expect that the 2023 average ocean temperatures at depth on the shelf edge and shelf were adequate for skates (AFSC longline survey: Siwicke, 2023, AFSC bottom trawl survey, O’Leary, 2023). Big skate are primarily found in western and central GOA, at depths of 2-800m, but primarily in nearshore waters at depths less than 100m. Skates spawn and eggs develop on the upper slope and outer shelf, and after hatching distribute across the shelf as juveniles and adults. Growth and development times for skate embryos are directly related to temperature and nursery sites occur within a narrow, undefined range of temperature on the shelf edge (Hoff 2008). Bottom temperatures on the shelf edge were average in 2023 but have been above average since 2019, with unknown potential impacts on skate embryos. Winds and surface currents can increase transport of eggs and larvae from offshore to nearshore nursery areas, and eddy activity can retain larvae nearshore (Bailey et al. 2008). The winter of 2022/2023 had variable eddy kinetic energy across the GOA, with above average eddy kinetic energy in the Haida and Seward locations and below average in the Sitka and Kodiak eddy locations, producing approximately average potential transport of larvae onto the shelf habitat (Cheng, 2023).

**Prey**: The status of skate prey is unknown with signs of decrease, although considered adequate given their generalist feeding habits. Small skates typically consume small crustaceans and polychaetes, while larger skates consume shrimp, crab, and fishes (Kemper et al.2017, Yang 2007, Orlov 1998, 2003). There were signs of decreased abundance in invertebrate prey (Tanner crab, shrimp, motile epifauna), although Tanner crab remains relatively high (ADF&G trawl survey:Worton, 2023, AFSC bottom trawl survey: Whitehouse, 2023). Polychaetes and infauna are not well monitored.

**Predators & Competitors**: There is no cause to suspect increased predation or competitive pressure on the Skate complex. Primary predators of skates include Pacific cod and P. halibut, for larval skates, and marine mammals (including sperm whales, sea lions) and dogfish, for adult skates. P. cod and P. halibut populations remain at relatively low abundance (Hulson 2023). Populations of Steller sea lions (5%-45% frequency of occurrence of skates in diet, Trites et al. 2007) have stabilized (eastern GOA) or remain greatly reduced (western GOA). Sperm whale populations (28% diet is skate, Wild et al., 2020) are not well known but not expected to have changed. Competitors with overlapping habitat and diets, may include deepwater flatfish (Dover sole) and rex sole.

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