1. **Overview of Data Poor Stock Assessment and Trajectory Modeling Approaches**
   1. **Overview of assessment approaches**

Data-poor stock assessments (DPSAs) use a number of clues about a fishery to provide relative information on the status of that fishery. By using clues such as length-frequency data taken from underwater visual transects, fish density inside and outside NTZs, or time series of CPUE data, these assessments are able to provide information on either the relative status of the biomass compared to an un-fished biomass, the relative status of the fishing mortality compared to natural mortality, or the relative status of current egg production compared to un-fished egg production. The outputs of these assessments can then be used by management to help inform harvest control rules. These types of assessments are used to examine a single stock of a single species. UCSB is currently employing five different assessment approaches. This section outlines the inputs, outputs, sensitivities, and caveats of each of these techniques.

1. **Average length (LBAR)**

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| **Description** | * This method uses fishery-dependent or fishery-independent length-frequency data. By looking at the minimum, maximum, and average length of the fish caught or observed, along with Von Bertalanffy growth parameters, an estimate of fishing mortality (F) can be estimated and compared to natural mortality (M). Intuitively, increasing fishing pressure will cause decreasing average length. Comparing the ratio F/M to a target ratio defined by stakeholders, a harvest control rule can be used adjust fishing pressure accordingly. |
| **Inputs** | * Fishery-dependent or fishery-independent length-frequency data * Life history parameters (Von Bertalanffy growth parameters, natural mortality) |
| **Outputs** | * An estimate of fishing mortality |
| **How this can be used by management** | * Stakeholders set management target F/M based on community objectives and thresholds of risk * Target F/M is compared with F/M from assessment * Effort is adjusted based on how far apart these values are |
| **Input Sensitivities** | * Estimate of natural mortality * Accuracy of individual fish length measurements |
| **Caveats** | * This method is dependent on reliably tracking changes in population size structure, and thus may be less accurate with small fast-growing species |

1. **No-take zone catch-curve (Catch Curve)**

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| **Description** | * This method utilizes fishery-independent length-frequency data taken from inside and outside a functioning NTZ. Assuming the population inside the NTZ is a proxy for an un-fished population, the downward slope of the length-frequency histogram taken from inside the NTZ can be used to calculate an estimate of natural mortality (M). The downward slope of the length-frequency histogram taken from outside the NTZ can be used to calculate an estimate of total mortality (Z). Fishing mortality can finally be calculated based on the difference between these two (F = Z – M). Comparing the ratio F/M to a target ratio defined by stakeholders, a harvest control rule can be used by to adjust fishing pressure accordingly. |
| **Inputs** | * Fishery-independent length-frequency data inside and outside the NTZ * Life history parameters (Von Bertalanffy growth parameters) * How many years the NTZ has been functioning and well-enforced |
| **Outputs** | * An estimate of fishing mortality |
| **How this can be used by management** | * Stakeholders set management target F/M based on community objectives and thresholds of risk * Target F/M is compared with F/M from assessment * Effort is adjusted based on how far apart these values are |
| **Input Sensitivities** | * Accuracy of individual fish length measurements |
| **Caveats** | * This method assumes that a fully-functioning and well-enforced NTZ has been sited appropriately and been in place long enough for the population living inside the NTZ to be a proxy for an un-fished population * Since this method uses NTZs as a proxy for un-fished populations, this method may also be less accurate for highly-mobile species that do not remain exclusively inside the NTZ * This method is dependent on reliably tracking changes in population size structure, and thus may be less accurate with small fast-growing species |

1. **NTZ density ratio (DR)**

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| **Description** | * This method uses the ratio of fish density inside a NTZ to the fish density outside the NTZ. The population living inside the NTZ acts as a proxy for what an un-fished population density would look like. Comparing this ratio to a target ratio defined by stakeholders, fishing pressure can be adjusted accordingly. |
| **Inputs** | * Fishery-dependent density data inside and outside the NTZ * Historical maximum density inside the NTZ |
| **Outputs** | * Ratio of fish density outside the NTZ to the density inside the NTZ |
| **How this can be used by management** | * Stakeholders set management target density ratio * This target ratio is compared to the ratio from assessment * Effort is adjusted based on how far apart these values are |
| **Input Sensitivities** | * Historical maximum density inside the NTZ |
| **Caveats** | * This method assumes that a fully-functioning and well-enforced NTZ has been sited appropriately and been in place long enough for the population living inside the NTZ to be a proxy for an un-fished population * Since this method uses NTZs as a proxy for un-fished populations, this method may also be less accurate for highly-mobile species that do not remain exclusively inside the NTZ |

1. **Length-based spawning potential ratio (LBSPR)**

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| **Description** | * This method uses fishery-dependent length-frequency data to calculate the spawning potential ratio (SPR) of a fishery. SPR is a measure of current egg production relative to maximum possible production at un-fished levels. Un-fished egg production is estimating using the natural mortality (M), growth rate (k), and maximum length. By comparing the estimated current SPR with a target SPR defined by stakeholders, a harvest control rule can be used to adjust a total allowable catch (TAC) accordingly. |
| **Inputs** | * Time series of fishery-dependent length-frequency data * Gear selectivity * Life history parameters (fecundity, growth rate, average maximum size, natural mortality) |
| **Outputs** | * SPR of target species |
| **How this can be used by management** | * Stakeholders set management target SPR * Target SPR is compared to SPR from assessment * Effort is adjusted based on how far apart these values are |
| **Input Sensitivities** | * Accuracy of individual fish length measurements * Assumed estimate of maximum length |
| **Caveats** | * This method is dependent on reliably tracking changes in population size structure, and thus may be less accurate with small fast-growing species |

1. **Decision tree (DTREE)**

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| **Description** | * This method uses time series fishery-independent CPUE and length-frequency data inside and outside a functioning NTZ. By looking at trends in CPUE and length-frequency data, and comparing these trends to expected trends in CPUE and length-frequency under a target SPR, total allowable catch (TAC) can be adjusted accodingly. |
| **Inputs** | * Time series of fishery-independent CPUE and length-frequency data inside and outside a NTZ * Life history parameters (Von Bertalanffy growth parameters, natural mortality, fecundity-to-length relationship) |
| **Outputs** | * Spawning potential ratio (SPR) of target species |
| **How this can be used by management** | * Stakeholders set management target SPR * Target SPR compared to SPR from assessment * Total allowable catch (TAC) is adjusted based on how far apart these values are |
| **Input Sensitivities** | * Accuracy of individual fish length measurements and CPUE data * Assumed life history parameters |
| **Caveats** | * This method assumes that a fully-functioning and well-enforced NTZ has been sited appropriately and been in place long enough for the population living inside the NTZ to be a proxy for an un-fished population * Since this method uses NTZs as a proxy for un-fished populations, this method may also be less accurate for highly-mobile species that do not remain exclusively inside the NTZ |