Appendix 1

The Definition of Compliance in the Context of the SONGS Mitigation Projects

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EXECUTIVE SUMMARY

The California Coastal Commission (CCC) has required Southern California Edison (SCE) and its partners to construct mitigation projects that provide adequate compensation for the loss of marine resources resulting from the operation of SONGS Units 2 and 3. The CCC is responsible for determining whether these projects are successful. One issue that resides at the core of this determination is the level and duration of performance by the mitigation projects that is needed to achieve compliance with specific conditions of the SONGS coastal development permit. We address this issue below.

The conditions of the SONGS coastal development permit (6-81-330-A) were amended in 1991 to mitigate the adverse impacts of the operation of SONGS Units 2 and 3 on the marine environment. The conditions that were amended to the permit require SCE and its partners to (1) create or substantially restore a minimum of 150 acres of southern California wetlands (Condition A), (2) install fish barrier devices at the power plant (Condition B), and (3) construct an artificial reef large enough to sustain 150 acres of medium to high density kelp bed community (Condition C). A fourth condition (Condition D) requires SCE to fund the Commission's oversight of the mitigation and independent monitoring functions identified in and required by Conditions A, B, and C. Physical and biological standards are identified in conditions A and C that specify how the wetland and reef mitigation projects should perform and the timing and level of monitoring that is needed to evaluate their performance. The specific requirements for attaining compliance of these conditions are discussed in various sections throughout the permit. The purpose of this document is to provide SCE with clear and consistent interpretations of key terms in the SONGS coastal development permit, which provide the basis for assessing compliance of SONGS wetland and reef mitigation projects. We identify the specific sections in the permit that provide support for our interpretations, and provide schedules for the different levels of monitoring that are required to determine whether the wetland and reef mitigation projects are in compliance with Conditions A and C.

INTRODUCTION

The SONGS coastal development permit (6-81-330-A) requires SCE to create or substantially restore a minimum of 150 acres of southern California wetlands (Condition A), and to construct an artificial reef large enough to sustain 150 acres of medium to high density kelp bed community (Condition C). Physical and biological standards are identified in these conditions that specify how the wetland and reef mitigation projects should perform and the timing and level of monitoring that is needed to evaluate their performance is discussed. The purpose of this document is to provide consistent interpretations of key terms in the SONGS coastal development permit (6-81-330-A), which provide the basis for assessing

compliance of SONGS wetland and reef mitigation projects. The specific sections in the SONGS permit that provide support for our interpretations are indicated by numerical superscripts in the text and are referenced below (see p. 6 of Appendix 1, **Permit language supporting CCC staff's interpretations on SONGS project compliance**).

DEFINITIONS

Monitoring Period: Post-construction monitoring will ensue upon completion of the reef construction and wetland restoration[1, 2]. The duration of such monitoring will last for a period not less than the full operating life of SONGS (defined below) plus years monitored without the project attaining compliance with permit standards[2, 3].

Compliance: The condition in which the performance standards are met.

*Compliance Perio*d: The number of years that a mitigation project is in compliance. The mitigation requirements will be fulfilled when the compliance period equals the total years of operation of SONGS Units 2 & 3, including decommissioning period to the extent that there is continuing entrainment or impingement or discharge of cooling water[3,4].

MONITORING EFFORT

Mitigation Reef (see Figure 1)

1) *Stage 1: Fully implemented monitoring*: Independent monitoring designed and conducted by CCC staff scientists will be done to evaluate the performance of the mitigation reef[5]. The sampling methodology, analytical techniques, and methods for measuring performance of the mitigation reef relative to the performance standards shall be described in the monitoring plan prepared for the mitigation reef[6]. Monitoring will ensue upon completion of the reef construction[2]. The performance standards must be met within 10 years[7,8]. The project will be considered successful when the performance standards have been met each year for three consecutive years[9]. Hence, fully implemented monitoring will last a minimum of 10 years. All years that the project is in compliance will count towards the compliance period. The level of sampling effort may be reduced during this stage of monitoring if analyses of the data indicate that compliance of the performance standards can be adequately assessed using less sampling effort. Remediation may be required if the performance standards are not met within ten years and if three consecutive years of compliance has not occurred within 12 years [10, 11]. Note that the Executive Director could prolong this stage of monitoring or reinstate it if necessary following degradation of the artificial reef (resulting in a period of non-compliance) or remediation[12].

2) *Stage 2: Annual site inspections:* Monitoring can be reduced to annual site inspections[13,14], which will serve to identify noncompliance with the performance standards, when:
    a. The project has been in compliance with permit standards for at least three consecutive years, and
    b. The project has been evaluated for at least ten years post-construction.

The schedule for monitoring the mitigation reef project is shown in Figure 1.

Restored Wetland (see Figure 2)

1) *Stage 1: Fully implemented monitoring:* Independent monitoring designed and conducted by CCC staff scientists will be done to evaluate the performance of the wetland restoration project[5]. A description of the monitoring can be found in the wetland monitoring plan and details of the monitoring effort will be set forth in a work plan[15]. Monitoring will ensue upon completion of wetland construction[16]. Within 4 years of construction, the total densities and number of species of fish, macro-invertebrates and birds shall be similar to the densities and number of species in similar habitats in the reference wetlands[17]. The performance standards must be met within 10 years, which is the same amount of time required for the mitigation reef to meet the performance standards[7,8]. The wetland restoration project will be considered successful when the performance standards have been met for each of three consecutive years[9]. All years that the project is in compliance will count towards the compliance period. Remediation may be required if the performance standards are not met within ten years and if three successive years of compliance has not occurred within 12 years[18]. Note that the Executive Director could prolong this stage of monitoring or reinstate it if necessary following remediation or degradation of the wetland (resulting in a period of non-compliance)[12].

2) *Stage 2: Scaled back monitoring:* Upon determination that the project has been in compliance for three consecutive years, a scaled back stage of monitoring will ensue[14]. The scaled back monitoring program will be designed and implemented by CCC staff scientists[5]. Reduction in effort will be based on analyses of data collected during the period in which the project was in compliance. Staff scientists will examine these data to determine the minimum effort that would have been necessary to assess compliance during the period**.** All monitoring, whether it is fully implemented or scaled back, must be sufficient for assessing compliance of the performance standards.

The schedule for monitoring the wetland restoration project is shown in Figure 2.

REMEDIATION

If the mitigation reef or restored wetland is not considered successful within 12 years post-construction or if the restored wetland has not met the biological community standard by year 4, then (at the discretion of the Executive Director):

1) The permittee shall fund an independent study to collect information needed to determine what remediation is required[19].
2) The permittee shall be required to implement any remedial measures determined necessary by the Executive Director in consultation with state and federal resource agencies and will provide funds for independent monitoring that evaluates the success of the required remediation[10,11,19]. Remediation monitoring may be different from the compliance monitoring required by the permit.

If the mitigation reef or restored wetland is in a period of reduced monitoring and if it falls out of compliance for a period of two consecutive years, then to determine if non-compliance is an artifact resulting from a reduction in monitoring effort, full monitoring (Stage1) may be re-established for those standards that are out of compliance. If resumption of full monitoring leads to the conclusion that the reduction in monitoring was responsible for non-compliance, then monitoring will remain at the full levels for the duration of the study or until the Executive Director concludes that reduced monitoring could be reinstituted[12]. CCC staff scientists will be responsible for designing and implementing the reduced monitoring program[5].

If resumption of full monitoring leads to the conclusion that non-compliance is due to poor performance of the mitigation project then:

1) The permittee shall be required to fund an independent study to collect the information necessary to determine what remediation is needed [19]
2) The permittee shall be required to implement any remedial measures determined necessary by the Executive Director in consultation with state and federal resource agencies and will provide funds for independent monitoring that evaluates the success of the required remediation[10,11,19]. Remediation monitoring may be different from the compliance monitoring required by the permit.

Permit (No. 6-81-330-A) language supporting CCC staff's interpretations on SONGS project compliance

1. (III.A.3.4). Upon completion of construction of the wetland, monitoring shall be conducted to measure the success of the wetland in achieving stated restoration goals (as specified in restoration plan) and in achieving performance standards, specified below.

2. (III.B. 2.4). Following completion of construction the mitigation reef shall be monitored for a period equivalent to the operating life of SONGS.

3. (III.A.3.0). Monitoring, management (including maintenance), and remediation shall be conducted over the "full operating life" of SONGS Units 2 and 3**.** Full operating life" as defined in this permit includes past and future years of operation of SONGS units 2 and 3 including the decommissioning period to the extent there are continuing discharges. The number of past operating years at the time the wetland is ultimately constructed, shall be added to the number of future operating years and decommission period, to determine the length of the monitoring, management and remediation requirement.

4. (III.B 2.4). The permittee shall insure that the performance standards and goals set forth in this condition will be met for at least the length of time equivalent to the full operating life of SONGS Units 2 and 3…."Full operating life" as defined in this permit includes past and future years of operation of SONGS Units 2 and 3, including the decommissioning period to the extent there are continuing discharges.

5. (III.C.1.0). Personnel with appropriate scientific or technical training and skills will, under the direction of the Executive Director, oversee the mitigation and monitoring functions identified and required by conditions II-A through C. The Executive Director will retain approximately two scientists and one administrative support staff to perform this function.

This technical staff will oversee the preconstruction and post-construction site assessments, mitigation project design and implementation (conducted by permittee), and monitoring activities (including plan preparation); the field work will be done by contractors under the Executive Director's direction. The contractors will be responsible for collecting the data, analyzing and interpreting it, and reporting to the Executive Director.

6. (III.B.2.4. A monitoring plan for the mitigation reef shall be developed by the Commission staff scientists pursuant to Condition D. The monitoring plan shall be completed within six months of approval of a coastal development permit for the mitigation reef proposed in a final plan developed pursuant to this condition.

The monitoring plan shall provide an overall framework to guide the monitoring work. The monitoring plan shall describe the sampling methodology, analytical techniques, and methods for measuring performance of the mitigation reef relative to the performance standards identified below.

7. (III.B.2.4). The independent monitoring program for the mitigation reef shall be designed to assess whether the performance standards have been met. If these standards are met after ten years following the completion of construction, then monitoring can be reduced to annual site inspections.

8. (III.B.2.4). If the standards listed above are not met within ten years after reef construction, then the permittee shall undertake those remedial actions the Executive Director deems appropriate and feasible.

9. (III.C.3.0). The mitigation projects will be successful when all performance standards have been met each year for a three-year period. The Executive Director shall report to the Commission upon determining that all of the performance standards have been met for three years and that the project is deemed successful.

10. (III.B.2.4). The permittee shall undertake necessary remedial actions based on the monitoring results and annual site inspections for the full operating life of the SONGS Units 2 and 3.

11. (III.B.2.4). If the standards listed above are not met within ten years after reef construction, then the permittee shall undertake those remedial actions the Executive Director deems appropriate and feasible.

12. (III.C.3.0). If subsequent monitoring shows that a standard is no longer being met, monitoring may be increased to previous levels, as determined necessary by the Executive Director.

13. (III.B.2.4). The independent monitoring program for the mitigation reef shall be designed to assess whether the performance standards have been met. If these standards are met after ten years following the completion of construction, then monitoring can be reduced to annual site inspections.

14. (III.C.3.0). If the Commission determines that the performance standards have been met and the project is successful, the monitoring program will be scaled down, as recommended by the Executive Director and approved by the Commission. A public review shall thereafter occur every five years, or sooner if called for by the Executive Director.

15. (III.A.3.1). A monitoring and management plan will be developed in consultation with the permittee and appropriate wildlife agencies, concurrently with the preparation of the restoration plan, to provide an overall framework to guide the monitoring work. It will include an overall description of the studies to be conducted over the course of the monitoring program and a description of management tasks that are anticipated, such as trash removal. Details of the monitoring studies and management tasks will be set forth in a work program.

16. (III.A.3.4). Upon completion of construction of the wetland, monitoring shall be conducted to measure the success of the wetland in achieving stated restoration goals (as specified in restoration plan) and in achieving performance standards.

17. (III.A.3.4.b.1). *Biological Communities.* Within 4 years of construction, the total densities and number of species of fish, macroinvertebrates and birds shall be similar to the densities and number of species in similar habitats in the reference wetlands.

18. (III.A.3.4). The permittee shall be fully responsible for any failure to meet these goals and standards during the full operational years of SONGS Units 2 and 3. Upon determining that the goals or standards are not achieved, the Executive Director shall prescribe remedial measures, after consultation with the permittee, which shall be immediately implemented by the permittee with Commission staff direction. If the permittee does not agree that remediation is necessary, the matter may be set for hearing and disposition by the Commission.

19. (III.B.2.4). Executive Director may also use any other information available to determine whether the performance standards are being met. If information from the annual site inspections or other sources suggests the performance standards are not being met, then the permittee shall be required to fund an independent study to collect the information necessary to determine what remediation is needed. The Executive Director shall determine the required remedial actions based on information from the independent study. The permittee shall be required to implement any remedial measures determined necessary by the Executive Director in consultation with state and federal resource agencies, as well as provide funds for independent monitoring that evaluates the success of the required remediation. As described under the funding option (Condition D) of this permit, the cost of remediation shall not be limited if the permittee elects to implement the mitigation reef.

Figure 1. Idealized monitoring schedule for the mitigation reef showing the minimum time periods for the two stages of monitoring: (1) Fully implemented monitoring and (2) annual site inspection. The actual time periods for each stage may be longer, depending on the performance of the project.

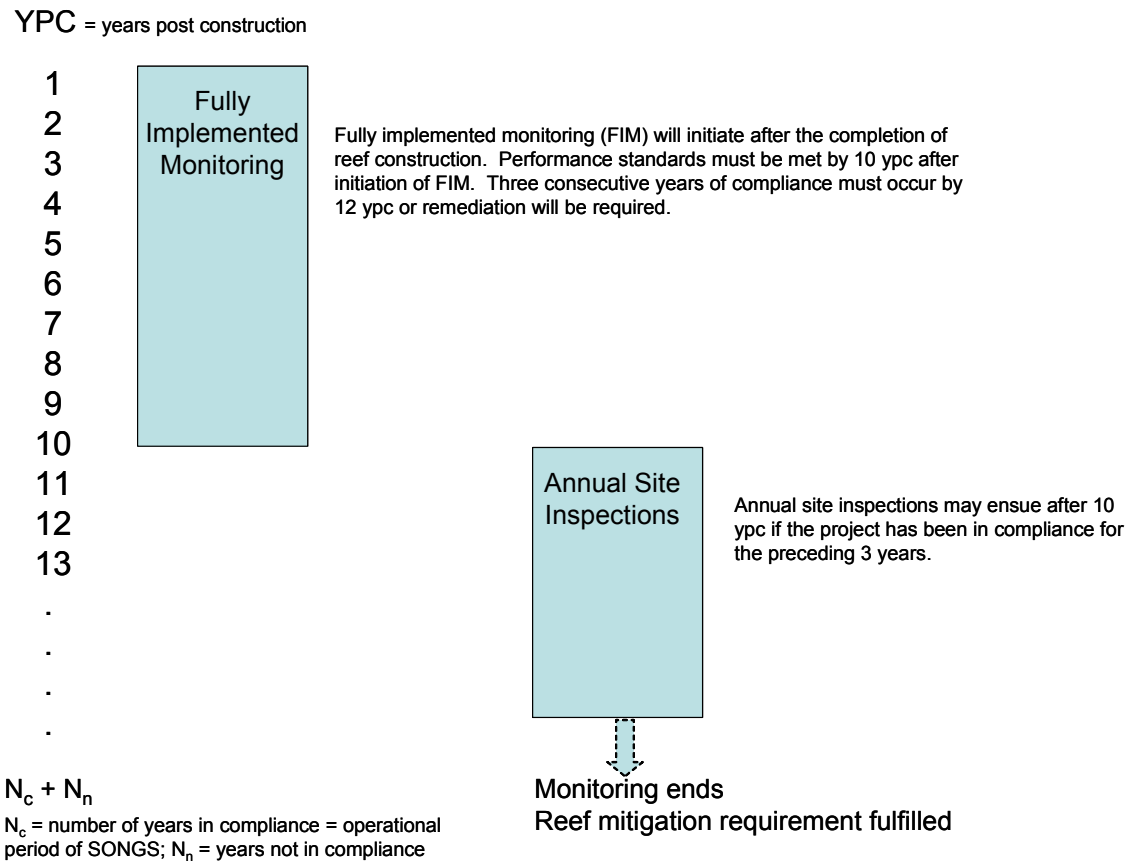
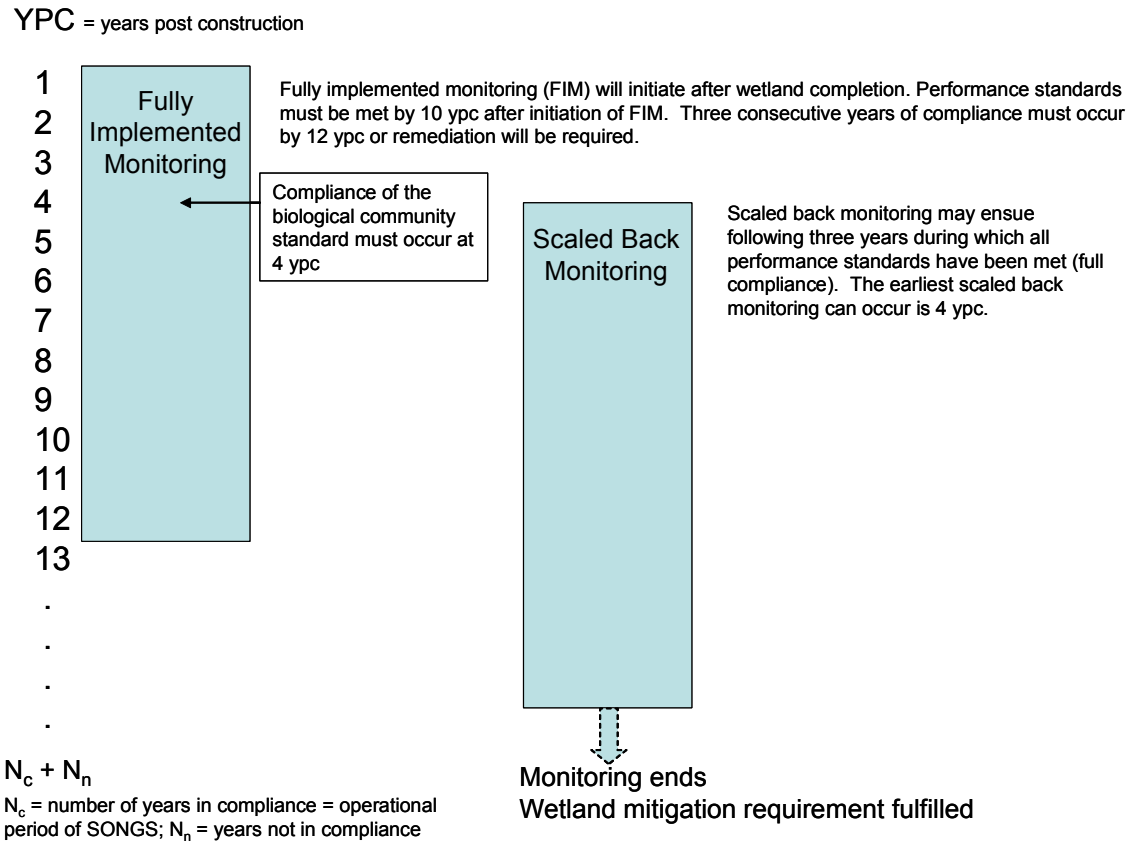


Figure 2. Idealized monitoring schedule for the wetland restoration project showing the minimum time periods for the two phases of monitoring: (1) Fully implemented monitoring and (2) scaled back monitoring. The actual time periods for each phase may be longer, depending on the performance of the project.



APPENDIX 2

METHODS FOR ESTIMATING FISH REPRODUCTIVE RATES

General Methods

Fecundity of several species will be measured during their reproductive period. Six target species are currently being considered because they are among the most abundant fishes on the study reefs and they represent a range of feeding a reproductive modes (Table 2, Monitoring plan for SONGS Mitigation Reef), but other abundant species may also be used. Females of egg-laying species will be collected during their spawning season and females of live-bearing species will be collected just before parturition. Collections of the five egg-laying species currently under consideration would be made during summer (June to September); and the live bearer (black perch) would be collected during April. Specimens will be collected via hook and line, small-mesh gill nets, other nets and traps, and spear.

All common egg-laying species at the study sites are batch spawners, that is, they spawn multiple batches of eggs throughout a single spawning season. On the day that a batch of eggs is spawned, the eggs are first hydrated within the ovaries and then ovulated. Hydrated ova appear only within hours of spawning and are recognized by their relatively large size and translucent appearance.

A reasonable estimate of annual fecundity (*F*) for an individual female batch spawner is:

$$F = bs$$

Where *b* is the number of hydrated eggs in the ovaries on any given day during the spawning season, and *s* is the spawning frequency (i.e., the number of times that a female spawns during a given year).

Because spawning frequency is difficult to measure directly for any individual, we will estimate *s* as:

$$s = pt$$

where *p* is the average proportion of females with hydrated eggs on a given day, and *t* is the number of days in the spawning season.

Substituting *pt for s,* we will estimate the annual fecundity for an individual female batch spawner (*F*) as the product of three measured variables:

$$F = bpt$$

Live bearing fishes in California kelp forests reproduce no more than once a year. Their annual fecundity is simply the number of embryos produced per female per year. This number can be easily determined from females collected shortly before parturition. The proportion of females that reproduce each year is simply the proportion of pregnant females in the population of mature females.

Collection and Processing of Fish

I. Egg-Laying Species

Fish will be collected throughout the spawning season at several representative locations at each site. We will aim to capture at least 50 females with hydrated eggs in their ovaries from each site for each year sampled. In the field, the body cavity of each specimen will be opened and the sex and stage of development of the ovaries of females will be noted. Ovaries will be classified based on macroscopic examination as immature/inactive (no obvious oocytes); mature (obvious oocytes but none hydrated); and ripe (hydrated oocytes present). Specimens will be kept on ice until they can be processed in the laboratory (no more than 24 h).

In the laboratory, each fish will be weighed to the nearest 0.1 gram, and measured for total length, standard length, and body depth and girth (i.e., circumference) at the third dorsal spine. A digital photo of each fish will be taken side-on, with the fish on a gridded background, allowing additional morphometric measurements to be made later if deemed necessary. The morphological measurements will be used to investigate the feasibility of obtaining measurements that can be used as non-destructive predictors of fecundity. Sagittal otoliths will also be removed from each specimen for age and growth analysis needed for evaluating the performance standard 10 (Fish production). Ovaries from female fish will be removed, blotted dry, weighed to the nearest 0.1 g. Ovary-free body weight will be determined by subtracting the ovary weight from the body weight. Ovaries will be preserved in 10% formalin for fecundity analysis in the laboratory.

Batch fecundity and spawning frequency will be estimated using hydrated eggs. It is usually impractical to count all of the hydrated ova within the ovaries of a female, so batch fecundity will be estimated as the product of the mean number of hydrated ova per gram of ovary and the total ovary weight. The preserved ovaries will be blotted dry and weighed to 0.01 g and then three subsamples will be removed and each weighed to 0.001 g. The number of hydrated ova in each subsample will be counted under a dissecting scope and the mean number of hydrated ova per gram of ovarian tissue will be determined from these three samples.

II. Live-Bearing Species

Livebearers will be collected from several representative locations at each reef just before parturition (e.g., mid to late April for black perch). Fish will either be processed in the laboratory within 24 h or frozen for later processing. In the laboratory, each fish will be weighed to the nearest 0.1 gram, and measured for body depth and girth at the third dorsal spine. A digital photo of each fish will be taken side-on, with the fish on a gridded background, allowing additional morphometric measurements to be made later if deemed necessary. Embryos will be removed from pregnant females, measured to the nearest mm standard length, blotted dry, and weighed to the nearest 0.01 g. Young-free body weight

will be determined by subtracting the total weight for the young fish from the body weight. Sagittal otoliths will also be removed from each specimen for age and growth analysis for evaluating the performance standard for fish production.

APPENDIX 3

METHODS FOR ESTIMATING FISH PRODUCTION

This document describes the approach that will be used to estimate annual production of fish tissue using data on length, density, somatic growth rates, and production of reproductive tissues for a select group of target species. The result will be an estimate of production per unit area of reef for each species. The approach is conceptually similar to that used by DeMartini et al. (1994), but differs in the details of the production model and some of methods used to estimate key parameters. This approach to estimating tissue production includes production of both somatic and reproductive tissues. Hence, total production of tissue biomass for a given species is:

$$P_{TOTAL} = P_{St} + P_{Rt}$$

where P_{St} is production of soma and P_{Rr} is production of gonadal tissue over some time period t.

P_{St} is estimated as:

$$P_{S_t} = \sum_{i=1}^{n} (\overline{N}_{i_t} \bullet g_{i_t})$$

where $\overline{N}_{it}$ = mean population density of size class *i,during period t,* and g_{it} is the average growth increment (mass) of individuals in size class *i* over time period t.

P_{Rt} is estimated as:

$$P_{Rt} = P_{Ft} + P_{Mt}$$

where P_{Ft} is production of eggs by females in all size classes and P_{Mt} is production of milt (sperm and semen) by males in all size classes over time period t.

P_{Ft} is estimated as:

$$P_{F_t} = \sum_{i=1}^{n} (\overline{N}_{F,i_t} \bullet E_i \bullet w_e)$$

where $N_{F,it}$ = density of females in size class *I during period t;* E_i =mean number of eggs produced by a female in size class *i*; and w_e is the average weight of an egg.

P_M is estimated as:

$$P_{M_t} = \sum_{i=1}^{n} (\overline{N}_{M,i_t} \bullet E_i \bullet w_e \bullet r_i)$$

where $N_{M,it}$ = density of males in cohort *i during time t*; and r_i is the ratio of testes weight to ovary weight for males and females in cohort *i*. Thus, milt production, which is not readily measured, is estimated based on the ratio of testes to ovary size.

Parameter estimation

The equations above include several parameters that must be estimated. These will all be estimated with data collected from the three field sites.

N_{it} — The density of individuals in a size class during time t will be determined from field surveys of fish density and size structure.

N_{Ft} and N_{Mt} — The density of females and males in each size class during period t will be estimated from total densities in field surveys and sex ratios determined from the work on reproductive output.

g_{it} — cohort specific growth increments over period t will be estimated for the year preceding capture by back-calculation from otoliths of fishes collected for the work on reproduction and supplemented with collections of juveniles. In brief, somatic growth will be estimated from otolith growth for species where clear increments are present and a tight relationship between otolith size and body size exists.

E_i — Per capita egg production will be estimated as the product of the batch fecundity and the number reproductive bouts per year.

w_e — Egg weight will be estimated from the largest 20% of yolked (but not hydrated) eggs in a large, random selection of ovaries of each species. Egg weight will be calculated as egg volume in cc (using measured radius and assuming spherical shape) times a specific gravity of 1.

r_i — Ratio of testes to ovary weights will be calculated for each size class from samples collected for the reproduction standard. Only mature, reproductively active fish will be used in estimating this ratio; and only females with mature but non-hydrated eggs will be used.