A simulation analysis to derive cost-optimised mark-recapture designs for estimating the biomass of east coast North Island snapper (*Pagrus auratus*) sub-stocks (SNA 1)

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EXECUTIVE SUMMARY

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An evaluation of designs for assessing SNA 1 stock biomass with mark-recapture was undertaken using a series of model simulations. A spatially explicit operating model was used to generate observational data for input to a tagging estimator. The operating model was specified pursuant to current SNA 1 assessment knowledge and was capable of producing complex movement dynamics and growth over an 18 month tag recovery period. The range of tagging programme designs investigated involved a combination of varying numbers of tags released, percentages of commercial catch examined for marks, and the effect of estimating the biomass of three or eight explicit spatial strata. Evaluations of estimator performance (bias and precision) were made against the operating model version of reality. Cost benefit investigations were undertaken to find the optimum cost trade-off between numbers of tags released and percentage of catch examined.

The operating model reality used in the simulations was based on eight explicit spatial strata with complex underlying movement. Only the eight stratum estimator was capable of exactly matching the movement complexities, yet as it transpired the three stratum estimator performed better than the eight stratum estimator over most design scenarios under homogeneous mixing. The three stratum estimator also attained reasonable fits to the tag movement observations and estimated movement at the three stratum level reasonably well. Indications were that the eight stratum design would only start to outperform the three stratum design at very high levels of expected tag recoveries (more than 3500). The likely reason for the eight stratum design performing poorly at low tag recovery levels is the large number of estimable parameters this design requires; 136 (compared with 41 for the three stratum design). At low to moderate tag recovery levels the ratio of tags to parameters for the eight stratum design is significantly lower than for the three stratum design. Hence the inherent estimation biases are greater for the same number of tag recoveries under an eight stratum design. An important conclusion to be drawn from the simulations is that it is better to ignore spatial heterogeneity in the tagging results unless there are a significantly large number of tag recoveries available to represent the very large parameter space needed to account for it.

The estimator did very well at predicting and accounting for growth even at low tag recovery scenarios (approximately 300 tags).

Biomass was reasonably well estimated for all length bins with the exception of the largest length bin, where the tendency was for biomass to be underestimated. The root cause of underestimation of the largest length bin was the need to use some proxy (usually a commercial method with known selectivity characteristics) of proportional length frequency to scale the population numbers estimate to weight. The level of bias in the largest fish bin did not overly influence the total population biomass estimates. The level of size-selection bias introduced in the simulation process was a function of current longline selectivity estimates. If these selectivity estimates are reasonable then the simulation process suggests that the overall population estimates from a future SNA 1 tagging programme are unlikely to be significantly biased by error in the largest length bin.

The overall conclusion was that if the distribution of tags in the population is relatively homogeneous (i.e. not extremely heterogeneous), relatively precise and accurate estimates of biomass could be obtained for the east Northland, Hauraki Gulf and Bay of Plenty sub-stocks from the recovery of 1500 to 2000 tags. Optimisations specific to this range of tag recoveries put the cost of a future SNA 1 tagging programme at between $5,750,000 and $6,250,000 (in 2009 dollars exclusive of GST). Experience gained in over 25 years of investigation of snapper tagging data means that we now have the knowledge and assessment tools to implement a SNA 1 tagging study capable of addressing all

significant sources of bias and delivering accurate and precise estimates of sub-stock biomass, population length composition and gear selectivity (i.e. selectivity relative to 9–10 length categories) and estimates of proportional movement between the three main sub-stocks.

1 INTRODUCTION

Snapper (*Pagrus auratus*) is New Zealand's most valuable commercial coastal marine species and by virtue of its high abundance around the populous regions of northern New Zealand it is also the nation's most important recreational species (Hartill et al. 2007). Most New Zealand snapper stocks have been subject to significant exploitation for over a century; national commercial landings peaked in the 1970s at around 18000 t per annum (Paul 1977; Ministry of Fisheries 2008). Commercial exploitation of snapper has been constrained by quota since the introduction of the Quota Management System (QMS) in 1986. Non-commercial snapper exploitation is not subject to quota and is regulated solely by minimum-legal-size and individual bag limits.

Under the QMS there are four snapper Quota Management Areas (QMAs) of commercial and non-commercial significance (Figure 1). The largest volume of catch, both commercial and non-commercial, comes from the east coast Northland QMA known as SNA 1 (Figure 1).

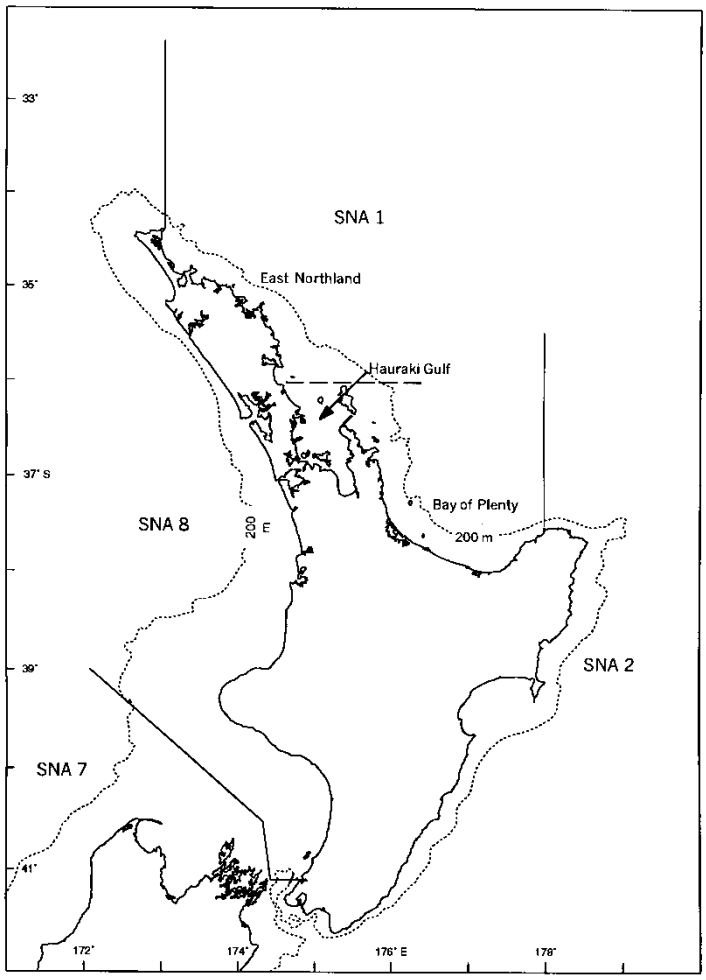


Figure 1: **Snapper Quota Management Area boundaries**

Tagging movement, recruitment and growth data suggest SNA 1 contains separate stocks from the other three QMAs (Sullivan 1985; Walsh et al. 2006b). Fishing pressure across SNA 1 has not been uniform and this is reflected in differences in age composition between SNA 1's three component sub-areas: east Northland, Hauraki Gulf, and Bay of Plenty (Paul 1977; Sullivan 1985; Davies & Walsh 1995: Figure 1). Recent east Northland catches show a wider range of age classes and a higher accumulation of biomass older than 20 years than catches from the other areas suggesting that it has been less intensely fished (Walsh et al. 2006a). The least accumulation of biomass in the older age classes in seen in Bay of Plenty catches (Walsh et al. 2006a), and it is believed that this is a legacy of a relatively high level of bottom trawl fishing pressure during the 1970s. Despite spatial productivity differences, tagging observations suggest that the level of mixing between the three sub-stocks is significant (Sullivan et al. 1988; Gilbert & McKenzie 1999). The areas also appear to have similar recruitment characteristics (Walsh et al. 2006a).

The spatial complexity of SNA 1 makes it problematic to assess as a unit stock as was done in early assessments (Gilbert & Sullivan 1994). The recent approach has been to model sub-stock productivity independently (Gilbert et al. 2000); the overall SNA 1 yield statistic being the combination of the individual assessments. Both approaches have problems: amalgamation results in an assessment inherently more uncertain because spatial variability is unaccounted for; assessing the sub-stocks independently, although accounting for spatial variability, largely ignores connectivity processes and may result in a biased assessment. The now preferable approach is to explicitly model stock spatial complexity accounting for movement (diffusion) between spatial areas. To do this good estimates of movement are needed.

If certain assumptions are met, mark-recapture can provide absolute estimates of recruited stock numbers/biomass and sub-stock mixing rates. Snapper is amenable to tagging assessment because its predominately shallow coastal distribution means that the majority of the population is accessible for tagging, and a high proportion of fish survive catch and release. Since 1981 there have been five major snapper tagging programmes, each more logistically and analytically complex than its predecessor (Sullivan et al 1988; Kirk & Ryan 1988; McKenzie & Davies 1996; Davies 1999; Davies et al. 2006). Compared to other stock assessment monitoring options, tagging programmes are very expensive; consequently there has been high reluctance to undertake tagging assessments on New Zealand snapper stocks at intervals of less than ten years. The assessment of SNA 1 has been updated twice on the basis of two tagging programme biomass estimates; one in 1985 and the second in 1994 (McKenzie & Davies 1996; Davies 1999).

In 2001 the intention was to conduct a third SNA 1 tagging programme in 2005. To this end NIWA in 2003 was contracted to evaluate designs and provide indicative costs for a 2005 SNA 1 tagging programme. Although the Ministry Working Group approved the final set of SNA 1 tagging design simulations in February 2009, the high costs have precluded a third tagging programme.

This report summarises the methodologies and SNA 1 tag simulation results and fulfils Objective 1 of Ministry of Fisheries stock assessment project SNA200305 i.e.:

"To design a mark-recapture programme in order to estimate the absolute biomass of snapper in SNA 1 and the selectivity of the main fishing methods used in the SNA 1 fishery"

2 METHODS

2.1 Overview of the tagging programme design simulation process

A computer based simulation approach was used to determine the optimum number of tags to release, the optimum quantity of commercial catch to subsequently examine for marks, and the level of spatial stratification needed in the design.

At the core of the tag design simulation process were two models:

1. An operating model: The purpose of the operating model was to generate tagging observational data for an assessment estimation process. This model needed to be capable of representing the main processes and biases (section 2.2) likely to occur in a SNA 1 wide tagging programme.

2. An estimator model: The function being to estimate stock parameters of explicit interest (number, biomass, movement) using observational data supplied by the operating model.

Estimator performance was evaluated in terms of bias and precision expressed relative to the operating model reality. Also factored into the optimisation is a consideration of the cost of releasing a given number of tags and the cost of examining a given amount of catch; the goal being to find an optimum trade-off between these two costs.

The tag design simulation/evaluation process consists of five components (Figure 2):

1. A tagged population 'functional reality'; specifications defined *a priori*

2. A population operating model or simulator

3. A tagging estimator model

4. A set of candidate designs

5. A cost benefit evaluation process

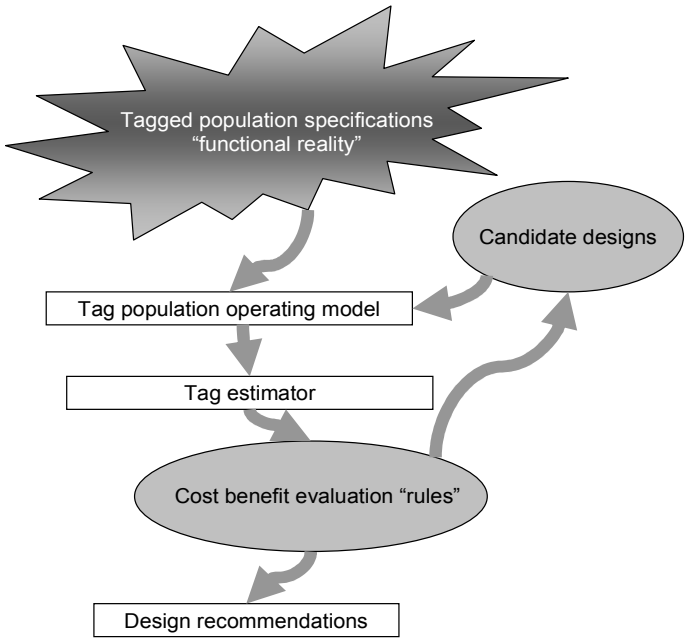


Figure 2: Components in the tag design evaluation process

Defining specifications for the operating model 'functional reality' was in some ways the hardest part of the SNA 1 tag simulation process largely because the assumed level of population complexity would largely govern the cost of the tagging programme design to estimate it. The Working Group was reluctant for the simulations to stray too far outside a basic level of spatial complexity largely because of the need to specify parameters which were difficult to substantiate with real observations. The WG recommended that the operating model stock-size assumptions should reflect the upper 95% range from the SNA 1 1995 tagging programme estimates (Davies et al. 1999).

2.2 Sources of bias specific to New Zealand snapper tagging programmes

A key assumption in all tagging analyses is that tagged and untagged animals are changing or acting in the same way; biases can occur when this assumption is violated. The fundamental metric is the population ratio of marked to unmarked animals (Appendix 1). The tagging release event establishes the initial tagging ratio being specific to an area or cohort at a fixed point in time (i.e. the time of release). Observations of tagged animals are typically made over a wide time interval after release. A key assumption (when the purpose of tagging is to estimate population size) is that the initial tagging ratio or mark-rate remains constant through time such that when no more tagged animals are seen in an area it is correct to assume that all the original population have left the area or have died. Most of the analytical complexity associated with tagging population estimation involves accounting for temporal change in the underlying tagging-ratio(s). The goal of the analysis is to estimate the initial population tagging ratio and from this the population size **at the time of tagging**. Immigration and recruitment are major causes of temporal change in the tagging-ratio as these processes only modify the untagged fraction of the population. As a generality, removal processes, e.g. mortality and emigration, can often be discounted or ignored if acting on tagged and untagged animals in the same way.

All New Zealand snapper tagging biomass estimates have been based on commercial tag recoveries because the total amount of examined catch is known with some certainty. Typically, in order to

obtain a suitable number of tag recoveries, a 12–18 month commercial catch examination period is required.

A number of potential sources of bias have been identified from past New Zealand snapper tagging programmes. Due consideration was given as to whether these would need to be explicitly accounted for in the simulation modelling process.

2.2.1 Initial mortality

Because the number of tags in the population has a direct proportional relationship with the tagging population estimate it is essential to know how many fish survive the tagging process i.e. the effective number of tags in the population.

It is not possible to estimate initial tag survival from the tag recovery rates alone; initial survival estimates can only be derived from independent observation or experiment. There have been three large net holding studies conducted since 1992 specifically to quantify initial mortality of tagged snapper under a range of capture treatments (NIWA unpublished data). The only difference between the treatment effects of the three studies was the type of tags used: in the first study external dart tags were used; the second study internal coded wire tags (McKenzie & Davies 1996); the third peritoneal plastic coated PIT tags. A meta-analysis on the combined data set found no significant difference in mortality could be attributed to tag type. The main determinates were treatments specific to capture method being depth for longline capture and weight of catch and fish-length for trawl caught snapper (Gilbert & McKenzie 1999). Functional relationships based on these influential parameters explained high levels of variation in the mortality experimental data (Appendix 2).

The general conclusion is that the experimental mortality estimates are unlikely to be improved with the additional of more experimental data. It was deemed that an initial mortality study would not be a requirement of a future SNA 1 tagging programme.

2.2.2 Inability to tag in deep water

Barotrauma issues and low catch-rates mean that it is not viable to tag snapper taken from depths greater than 75 m. Snapper occur in commercial quantities out to 120 m in SNA 1 so the inability to tag beyond 75 m means that there are significant spatial areas where no tags can be released. Past SNA 1 tagging analyses (Sullivan et al. 1988; McKenzie & Davies 1996) have assumed that movement of tagged fish from shallower to deeper waters was homogenous. Although tagged fish have been recovered from beyond 75 m, it is not possible to estimate the degree of interchange between shallow and deep water areas from the tagging data alone because reciprocal movement observations (from deep to shallow) are lacking. This means that it is impossible to distinguish between two equally plausible hypotheses to explain the observed number of tags recovered offshore: (1) a high degree of movement of inshore fish to a relatively large off-shore population; (2) a low degree of movement to a small off-shore population. In order to resolve the off-shore population estimate an independent measure of relative abundance between on and off-shore strata is required, for example from an independent CPUE analysis.

Since the precision in the off-shore estimate rests more with the precision of the relative abundance estimate (spatial CPUE analysis), than it does on the tagging design, it was decided not to incorporate the CPUE based estimation as part of the tag design evaluation. This was largely because it was assumed that the cost of the spatial CPUE analysis would be the same for all tagging designs, and hence part of the fixed cost estimate.

2.2.3 Trap-shyness

When there are two or more release methods and these methods are also used to recover tagged fish it becomes possible to investigate trap avoidance or trap shyness, i.e. tagged fish being less likely to be recaptured by the method that tagged them. Evidence of trap-shyness in longline tagged fish was found in the 1995 east coast snapper tagging programme recovery data (Gilbert & McKenzie 1999). Although trap-shyness should ideally have been included in the simulation process, it was not practical to do so; partly because the Working Group could not reach agreement as to the level of trap-shyness to use in simulations. It was assumed that a design capable of generating an acceptable level of precision on the overall biomass estimates would also be sufficient to estimate trap avoidance.

2.2.4 Spatial heterogeneity in tag-ratios

Spatial differences in tag-ratios are usually a result of inadequate mixing or failure to release tags in proportion to abundance. The solution for this is to divide the stock into a number of spatial strata and to derive separate population estimates for each of these.

At the fundamental design level three spatial areas were recognised: east Northland; Hauraki Gulf; and Bay of Plenty (Figure 1). The tagging programme's main goal was to provide estimates of the recruited snapper population numbers and biomass in each of these areas separately. The three SNA 1 sub-stock areas therefore constituted the minimum level of design stratification for a SNA 1 tagging programme. Ideally there should be no need to stratify the SNA 1 tagged population further, but because of evidence of finer scale mark-rate heterogeneity in past SNA 1 tagging programmes (Davies et al. 1999) it was deemed necessary to investigate the benefits of explicit spatial partitioning beyond the sub-stock level in the tag design simulations. To do this, eight distinct spatial areas (Figure 3) were recognised.

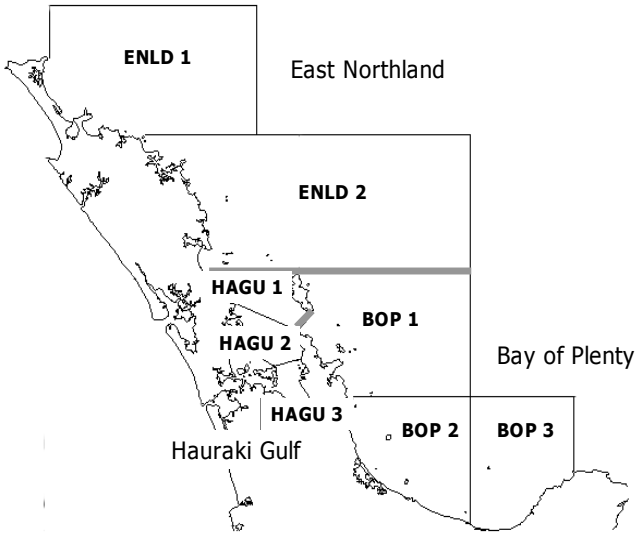


Figure 3: Eight spatial strata used to simulate spatial heterogeneity in tagging simulations

2.2.5 Inter-stratum movement

Interchange of tagged animals between all three sub-stock areas was observed in both previous SNA 1 tagging programmes (Sullivan et al. 1988; McKenzie & Davies 1996). In the analysis of the 1994 tagging programme an attempt was made to calculate the mixing rates analytically using a mixing variation of the Petersen equation (McKenzie & Davies 1996). The direct calculation method was not successful largely because of the high leverage effect of a small number of tag movement observations. The final solution for both the 1985 and 1994 tagging analyses was to ignore movement; tag recoveries made outside the area of release were assigned to the recovery area (Kevin Sullivan pers comm.; McKenzie & Davies 1996). It was assumed that the bias this would cause would be negligible. However, movement is clearly an important SNA 1 stock dynamic and future stock assessments will need to take account of it. An important goal for a future SNA 1 tagging programme is also to derive reliable estimates of sub-stock movement.

2.2.6 Length heterogeneity in tag-ratios

Differences in mark-rates across length categories were evident in both the 1985 and 1994 SNA 1 tag recovery data (Sullivan et al. 1988; McKenzie & Davies 1996); these differences were probably caused by the non-uniform selectivity characteristics of the two release methods (single trawl and longline). Size related mark-rate heterogeneity will almost certainly be a feature of future SNA 1 tagging programmes; the way to avoid biasing the final population estimates is to explicitly stratify the analysis by length.

2.2.7 Growth during the recovery period

In addition to immigration, growth is the process by which untagged fish enter the tagged fish population during the recovery period i.e. recruitment. The bias effect of growth is further exacerbated by the heterogeneous tag-ratios across the population length structure; specifically that the length heterogeneity pattern is likely to change through the course of the recovery period due to the differential growth rates of small and large fish. Accounting for growth effects will be essential in future SNA 1 tagging programme and the power to do this a critical design consideration.

Information needed to estimate growth can come from tag recovery observations. Estimating growth from tag increment data and implementing this in the tagging estimator is relatively straight forward (Francis 1988). The validity of using the tagged fish growth data to estimate population growth depends on the assumption that tagged and untagged fish growth rates are the same; evidence was found in the 2001 SNA 8 tagging programme that this assumption is not valid for snapper (Davies et al. 2006). In the SNA 8 assessment allowing for differential growth of tagged and untagged fish resulted in significantly different SNA 8 biomass estimates than when tagged and untagged growth was assumed to be the same. The SNA 8 results suggest that it will be necessary to obtain independent estimates of untagged fish growth in future SNA 1 tagging programmes. As with the SNA 8 tagging analysis, growth estimates for the untagged SNA 1 population are likely to come from independent catch-at-age sampling. The cost of collecting the independent growth data in SNA 1 is fixed, ie independent of the choice of tagging design. We have included growth estimation of untagged fish as a fixed component of the final cost estimates.

2.2.8 Tag recovery under-reporting/under-detection

Failure to report or detect tags in landed catches is similar to initial mortality, in that it has direct positive leverage on the population estimates. Cryptic internal electronic tagging technologies were used in the 1994 SNA 1 and 2001 SNA 8 tagging programmes. These technologies enabled accurate auditing and control of the catch examination/tag recovery process which made it possible to obtain

precise and accurate estimates of tag under-detection. Given the advances in tagging technologies since 2001, the level of tag under-detection and loss in a future SNA 1 tagging programme was assumed to be zero and hence was not explicitly considered in the simulations.

2.3 Operating model dynamics, data, and specifications

2.3.1 Stratum biomass and length frequencies

The SNA 1 tag operating model was configured with eight spatial strata combining to make three spatial stocks (Table 1).

Table 1: Level of spatial partition assumed by the SNA 1 tag operation model. Note: stock areas and stock and stratum numbers given in the table are used throughout the main text and in the appendices.

Stock	Stock number	Stratum number
East Northland	1	1
East Northland	1	2
Hauraki Gulf	2	3
Hauraki Gulf	2	4
Hauraki Gulf	2	5
Bay of Plenty	3	6
Bay of Plenty	3	7
Bay of Plenty	3	8

A priori, the SNA 1 population of interest is the stock fraction greater than 25 cm in length at the time of tagging. However, because the operating model needed to account for fish that would potentially grow into the 25 cm range during the 18 month recovery period the model's starting length was set at 15 cm. The operating model's length composition was divided across 86 one centimetre length bins (15–100 cm).

The individual stratum length compositions for the respective eight strata and three stock areas (Table 1) were derived as a composite of juvenile research trawl data (amalgamated surveys 1985–2000) and recent (2004–05 fishing year) commercial snapper longline length frequency observations. The commercial longline length composition data was adjusted for selectivity using functional parameters derived from the 1999 SNA 1 stock assessment (Davies et al. 1999). Stratum length frequencies were calculated (via a length weight relationship given in Ministry of Fisheries 2008) to achieve the desired stratum biomass (Table 2; Figure 4; Figure 5).

Table 2: **Biomass and numbers of fish above 25 cm assumed by the operating model.**

Stock	Stratum number	Biomass (t)	Numbers
East Northland	1	10 892	11 752 296
East Northland	2	5 516	6 980 234
Total		16 408	18 732 530
Hauraki Gulf	3	4 915	5 180 851
Hauraki Gulf	4	9 031	9 900 638
Hauraki Gulf	5	13 135	16 200 547
Total		27 081	31 282 036
Bay of Plenty	6	8 179	9 832 819
Bay of Plenty	7	4 994	5 549 953
Bay of Plenty	8	5 416	4 318 192
Total		18 589	19 700 964
SNA 1		62 078	69 715 530

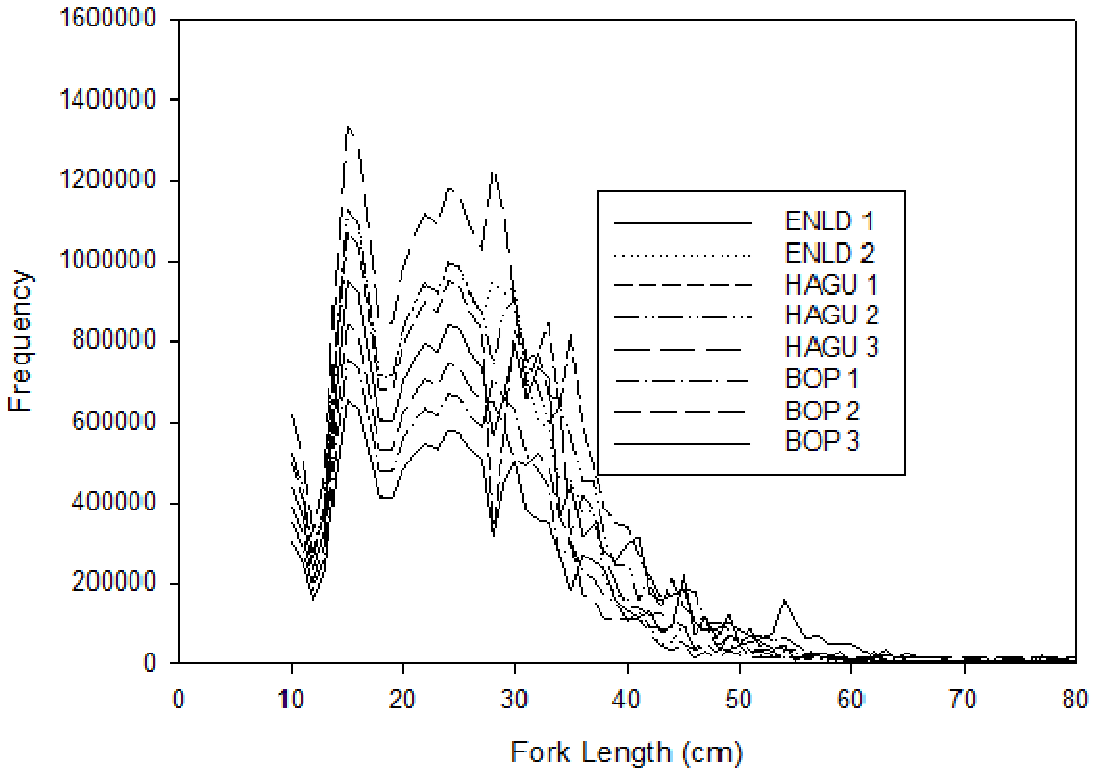


Figure 4: **Length frequency composition of the operating model spatial strata.**

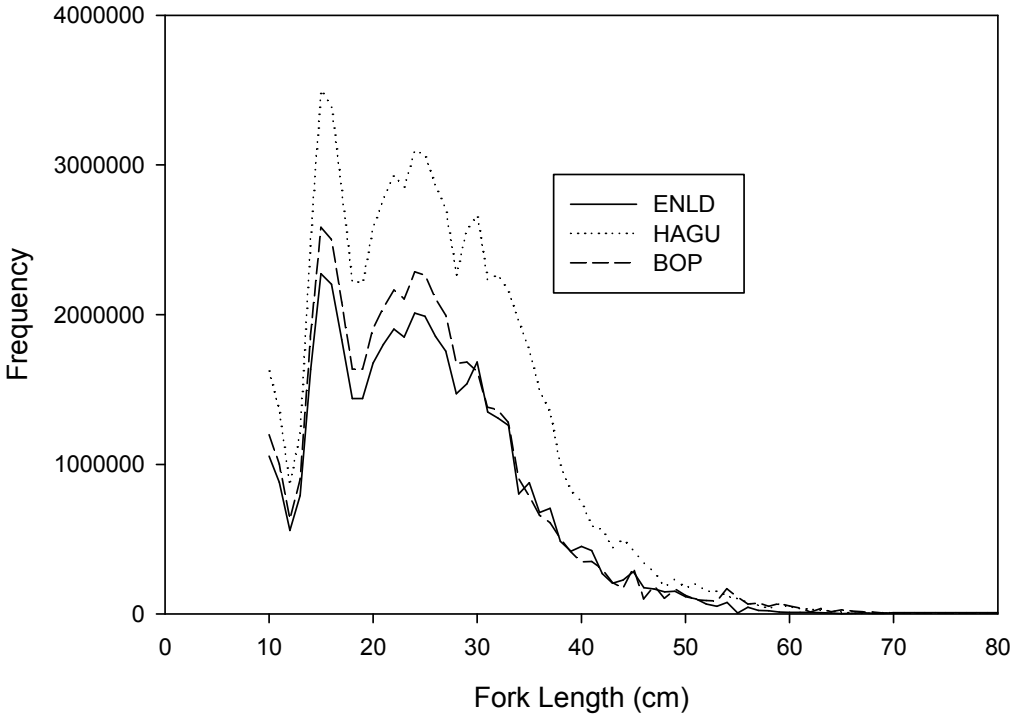


Figure 5: Combined stock stratum length frequencies

2.3.2 Generation of spatially heterogeneous and homogeneous tag release observations

Whereas the untagged population was represented in the operating model as length frequency vectors, the model kept track of individual tagged fish details (length, location and capture status). During the initial tagging sequence the operating model generated a tagged population, with each individual tagged fish assigned a release length, home stratum designation, and initial survival status (Appendix 2), and growth trajectory (Appendix 3). To do this the operating model used trawl and longline release shot data from the 1994 SNA 1 tagging programme (Ministry of Fisheries data). Release shots were randomly drawn from the total pool of all release shots (with replacement) by the operating model until the target number of releases was attained. The ratio of longline releases to trawl releases was set at 4:1; this being the ratio used in the 1994 SNA 1 tagging programme.

For the base-case simulation, the relative distribution of tags across strata was proportional to the actual number of fish in each stratum (Figure 6), i.e. the tag distribution or mark-rates were homogeneous. Simulations were also undertaken where the relative proportion of tags was different to the stratum population ratios (Figure 6); these were arbitrarily chosen to achieve an extreme level of spatial heterogeneity. The heterogeneous release scenario was investigated as a sensitivity to homogeneous mixing.

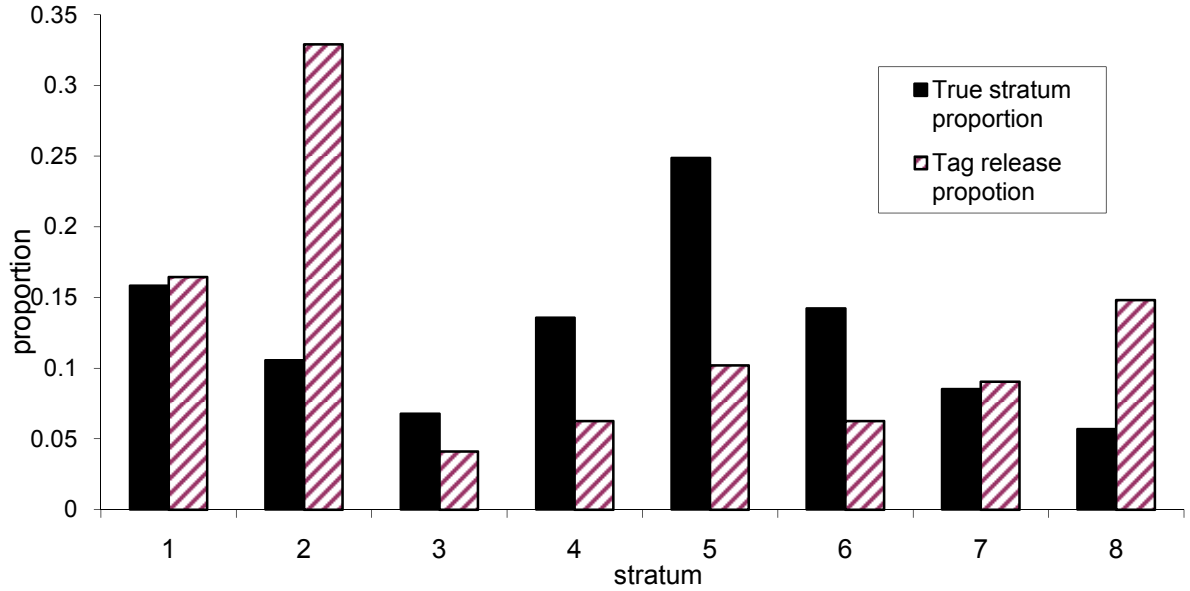


Figure 6: **The spatial distribution of tags compared to the spatial distribution of the SNA 1 population (numbers) as specified for the heterogeneous release simulations. (Note: for the base-case homogeneous simulations tag releases were exactly proportional to the stratum population numbers).**

2.3.3 Generation of examined-catch length frequencies

Average SNA 1 commercial catches from five recent fishing years were used to produce an area month and method catch profile (Table 3; Appendix 4). These catches defined the upper limit to the amount of catch that the operating model could examine from a given method in each month and stratum.

The operating model needed to replicate the expected landing length frequencies of the main SNA 1 commercial methods in each area in each recovery month (Table 3). To do this the operating model draw length frequency data from a set of individual SNA 1 longline landings sampled in 2004–05 and single trawl and Danish seine landings sampled in 1994-95 (random draws with replacement) until the target scanned catch weight for the month and stratum was attained. As there was no pre-existing catch sampling data for SNA 1 pair trawl and other methods the total catch available for simulation purposes was 4213 tonnes (the single trawl, longline and Danish seine total catch in 2008–09; Table 3).

Table 3: **Assumed annual SNA 1 catch (tonnes) by area and method; totals given are based on the average catches from five recent fishing years. Pair trawl and other method catches were not included in operating model simulations.**

Stock	Pair trawl	Single trawl	Longline	Danish seine	Other
Bay of Plenty	13	609	300	333	13
Hauraki Gulf	0	735	663	369	80
East Northland	157	510	572	122	22

2.3.4 Growth projection functions

Growth analyses undertaken for the 2002 SNA 8 tagging assessment found that an exponential growth model fitted the tag growth increment observations better than the more traditional linear von Bertalanffy growth model (Davies et al. 2006). The same exponential annual increment model was used to model growth (Appendix 3) in the SNA 1 tag simulations. This model has five estimable parameters (Appendix 3):

μ_α the mean annual growth increment for a fish of length α
μ_β the mean annual growth increment for a fish of length β
θ the amplitude of the seasonal growth limitation effect
ω the phase of the seasonal growth limitation effect
σ^2 the variance term of the log density function for μ_α μ_β

It was not essential for the tagging simulations that the operating model growth parameters were an accurate reflection of SNA 1 growth but it was deemed important that modelling growth was plausible for snapper. Exponential growth model parameter estimates were available from modelling analysis of the 2001 SNA 8 tagging data (Davies 2006) and these values were used to specify the operating model growth rates (Table 4).

Table 4: Exponential growth parameter values used by the operating model.

Stock	α	β	μ_α	μ_β	ω	θ	σ^2
ENLD	25	40	5.47	2.89	0.8	1	0.4263
HAGU	25	40	5.47	2.89	0.8	1	0.4263
BPLE	25	40	5.47	2.89	0.8	1	0.4263

The σ^2 term defines the degree of distributional spread a single length class will have after growth projection (Appendix 3). In combination the growth model was used by the model to construct the growth forward projection matrix. The forward projection matrix was then applied to the initial length frequency composition to generate the expected length composition at a given future time (see Appendix 3).

2.3.5 Movement models and parameterisation

2.3.5.1 Movement models

The estimation of movement in a population/tag modelling context has been accorded detailed consideration by researchers over the last fifty years, and many mathematical representations have been developed that have fisheries stock assessment utility (Darroch 1961; Seber 1982; Hilborn 1990; Brownie et al. 1993; Xiao 1996; Sibert et al. 1999; King & Brookes 2002; Aires-da-Silva et al. 2005). Movement can be expressed in two ways: as a proportional change, i.e. $P_{jk_{\Delta t}}$ being the proportion of j area fish moving to k over the time interval Δt or as an instantaneous probability, i.e. $\mathrm{P}[xj]$ being the probability of a fish moving from area x to j at any given instant. The important distinction is that probabilistic movement can be interpreted as an instantaneous rate i.e. the probability of an animal moving from one area to another at any given instant in time, whereas proportional movement more typically describes discrete time based change. A good theoretical description of fisheries-specific movement models is given in Quinn & Deriso (1999).

There are two fundamental movement dynamics that can be used to model fish movement; Markovian and Home Fidelity (HF).

Markovian movement

Most animal movement models are Markovian in that the parameters governing individual movement are specific to the area in which the animal currently resides. In other words the animal has no prior knowledge of a home area or of an area it visited in a previous time step that was better, it only knows the suitability or otherwise of the area in which it currently resides.

Markovian movement is typically modelled with a time dependant proportional shift ($\theta_{i\to j}$ Appendix 5). The combination of all possible movements to all areas is represented as a proportional movement matrix (Θ Appendix 5). A fundamental property of Markovian movement is that after multiple applications of the movement matrix (Θ) representing movement of tagged fish over successive time steps, all tagged fish will eventually achieve an equivalent proportional distributed across all strata independent of which stratum they were originally released from (Appendix 5).

Home fidelity movement

Under a home fidelity (HF) movement assumption, movement is an attribute of the individual fish not the area in which it currently resides. This invokes the concept that individual fish have a predisposition to regard a particularly area as home, e.g. "A" is my home but on occasion I visit "B". Adopting a home fidelity assumption implies the existence of cryptic Home populations (H_x). These populations are never observed, but the integration of their combined movements is observed.

HF movement can be modelled as an instantaneous probability $\mathrm{P}[xj]$ being the probability of an area x home fish (H_x) being found in area j. The matrix of home population movement probabilities ($\boldsymbol{\psi}$) across all strata represents the equilibrium distribution of all the home strata populations. The equilibrium distribution of H_x tagged fish is therefore attained in the model in the initial time step after one application of the $\boldsymbol{\psi}$ movement probability matrix (Appendix 6). In other words; after an initial mixing process (deemed by our operating model to be instantaneous) the cumulative spatial distribution of tagged fish will not change over successive time steps. Unlike Markovian movement the equilibrium distribution of marked animals in the population is dependent upon the initial relative stratum allocation of tags.

It has been a consistent observation in all past New Zealand snapper tagging programmes that the proportional distribution of tagged fish released in different spatial areas shows little change through time with the majority of tagged snapper recovered in their area of release (Gilbert & McKenzie 1999); these observations are inconsistent with the Markovian movement dynamic and this is why the home fidelity movement dynamic was chosen for SNA 1 tag simulation modelling.

2.3.5.2 Home Fidelity movement model parameterisation

The model developed for simulating tagged snapper movements termed the Home Fidelity movement model (HF model) appears to have no precedent in the literature.

The terms for the HF model dynamic used in the operating model were as follows:

n The total number of strata in the population

Δt The recovery period time interval

H_x The number of fish that consider stratum x as home (cryptic population)

$\mathrm{P}[xj]$ The instantaneous probability of observing an H_x fish in stratum j

ψ Matrix of instantaneous movement probabilities ($\mathrm{P}[xj]$)

N_{j_t} Total number of actual fish in stratum j at any time* t given by:

$$\sum_{x=1}^{n} \mathrm{P}[xj] H_x$$

Rel_{j_t} The effective total number of fish tagged in stratum j at time t

$\mathrm{Rel}\left[H_x\right]_{j_t}$ The effective number of H_x fish tagged in stratum j at time t is given by:

$$\frac{\mathrm{P}[xj] H_x}{N_{j_t}} \mathrm{Rel}_{j_t}$$

$\mathrm{Rel}_{jk_{\Delta t}}$ The effective total number of fish tagged in stratum j that are in stratum k over during the recovery period (Δt) is given by:

$$\sum_{x=1}^{n} \mathrm{Rel}\left[H_x\right]_{j_t} \mathrm{P}[xk]$$

$\mathrm{P}\left[\mathrm{Rel}_{jk_{\Delta t}}\right]$ Probability of encountering a j tagged fish in stratum k over Δt given by:

$$\frac{\mathrm{Rel}_{jk_{\Delta t}}}{N_{k_{\Delta t}}}$$

$C_{k_{\Delta t}}$ The total number of fish caught and examined for marks in stratum k over Δt

* Note: $N_{j_t} = N_{j_{\Delta t}}$ under closed population assumption and instantaneous equilibrium property of HF tagging model c.f. not the case for Markovian tag movement model when not at equilibrium

$\mathrm{E}\left[\mathrm{Rec}_{jk_{\Delta t}}\right]$ Expected number of recoveries of fish tagged in stratum *j* and recovered in stratum *k* over Δt given by:

$$C_{k_{\Delta t}}\mathrm{P}\left[\mathrm{Rel}_{jk_{\Delta t}}\right]$$

$P_{jk_{\Delta t}}$ The proportion of the actual population in stratum *j* at time *t* that has moved to stratum *k* over Δt is given by:

$$\frac{\mathrm{Rel}_{jk_{\Delta t}}}{\mathrm{Rel}_{j_t}}$$

These terms relate to a population **N** consisting of *n* spatial strata which will have *n* cryptic or home sub-populations, one corresponding to each stratum. At any given time *t* the actual number of fish in stratum *j* (N_j) will be predominantly made up of the cryptic home population of *j* (H_j) fish plus varying numbers of fish visiting from other strata ($H_{k\neq j}$).

In actuality we are only interested in knowing N_j and its associated movement dynamics ($P_{jk_{\Delta t}}$). As shown above, these parameters are derived from H_j and $\mathrm{P}[jk]$; the instantaneous probability of observing a H_j fish in stratum *k*.

The instantaneous equilibrium property of the HF model also means that the net change in the proportional distribution of actual tagged fish over Δt, i.e. $P_{jk_{\Delta t}}$, is the same for all recovery period intervals, i.e. $P_{jk_{\Delta t}} = P_{jk_{n\Delta t}}$ for all $n > 0$. The proportional movement matrix $P_{jk_{\Delta t}}$ can also be calculated more directly from the HF model's instantaneous parameters:

$$P_{jk_{\Delta t}} = \frac{\sum_{x=1}^{n}\mathrm{P}[xj]\mathrm{P}[xk]H_x}{\sum_{x=1}^{n}\mathrm{P}[xj]H_x}$$

The initial configuration of the SNA 1 tag operating model was specified by providing length frequencies for each of the eight home stratum populations (H_x) and parameter values for the instantaneous movement probability matrix ($\boldsymbol{\psi}$).

2.3.5.3 Derivation of HF movement matrix (ψ) parameter values

The general observation from past SNA 1 tagging programmes was that the proportion of tagged fish moving tended to fall off exponentially with increasing distance from the point-of-release (Gilbert and McKenzie 1999). A simple set of equations were specified as a function of the number of intermediate strata from the stratum of release (Appendix 7) to generate a set of movement matrix (ψ) parameters. The intention was to produce a heterogeneous (complex) pattern of inter-stratum movement observations which would be challenging for a tagging programme to estimate and not to precisely replicate the actual levels of inter-stratum movement observed in past SNA 1 tagging programmes (Appendix 7).

2.3.5.4 Specification of initial home (H_x) stratum length frequency distributions

The actual numbers of fish in each stratum that the operating model had to represent was specified *a priori* as described in section 2.3.1. Given ψ and the actual stratum population numbers it was possible to derive the individual home population numbers (H_x) for use by the operating model via Gaussian substitution (Appendix 6). Separate Gaussian transformations were required to generate the home stratum frequencies for each 1 cm length bin.

2.3.6 Operating model temporal dynamics

The 1994 SNA 1 tagging design allowed for a 5 month mixing phase followed by a 13 month recovery phase. After the initial tag event the operating model had to represent the tagged and untagged components of the SNA 1 population over 18 monthly time steps correctly accounting for both inter-stratum movement and growth. For monthly time steps 6 through 18 the model was required to produce a random number of tag recoveries from catches drawn from the population.

The tagged fish component of the population was individually modelled whereas the untagged component was modelled as stratified set of length frequency distributions. In each model iteration a sequential series of probabilities was applied in order to decide whether a given tagged fish was recaptured (Appendix 8). The model sequentially determined the recapture fate of all tagged fish (governed by its current length and location). The recovery data generation process required the model to loop through all scanned landing events for each tagged fish in turn (Appendix 8).

A tagged fish's initial survival status was assigned by the model at the time of tagging (Appendix 2). Also assigned at the time of tagging was the fish's home-stratum status. This was randomly assigned in accordance to the home-stratum ratios present in the area at the time of tagging; e.g. if 80% of the fish in stratum A at the time of tagging were A-home fish then a tagged fish had an 80% probability of being assigned A-home status. Once assigned, a tagged fish's home-status did not change.

For each sequential scanned catch in a given stratum the operating model would firstly determine if a particular tagged fish was in the stratum at the time the catch was taken (pursuant to the home movement probabilities) and secondly if it was present in the catch (Appendix 8). The probability of an individual tagged fish being in the first scanned catch is:

$$\mathrm{P}[\mathrm{tag}_x]_1 = \frac{C_{1j}}{N_j}$$

Where: C_{1j} is the number of fish in the 1st examined catch in area j and N_j is the total population in area j. The probability of an individual tagged fish being in the nth scanned catch and not in the preceding catches (given it was in the stratum at the time the catches were taken) is given by:

$$\mathrm{P}[\mathrm{tag}_x]_n = \frac{N_j - \sum_{j=1}^{n-1} C_{ij}}{N_j} \frac{C_{nj}}{N_j - \sum_{j=1}^{n-1} C_{ij}} = \frac{C_{nj}}{N_j}$$

The cancellation effect of the numerator term defining the probability of not recovering the tagged fish in the previous catches means that for the purposes of both simulation and estimation in tag recovery models the tag dilution effect of previous catch removals on the recapture probability of an individual tagged fish can be ignored.

The length of a given tagged fish in the operating model could be derived in each month in accordance with its individual growth parameters (Appendix 3). The growth projection of the original stratum length frequencies was achieved via a growth transition matrix (Appendix 3). However, it was not possible to project each successive month's length composition to the next month because, for most fish, the amount of within-month incremental growth was insufficient to move fish out of their starting centimetre length bin. The solution was to grow all fish relative to the initial starting month (T0) in a single step e.g. month T0 to month T18 as a single projection, T0 to month T17 as a single projection and so on (Figure 7).

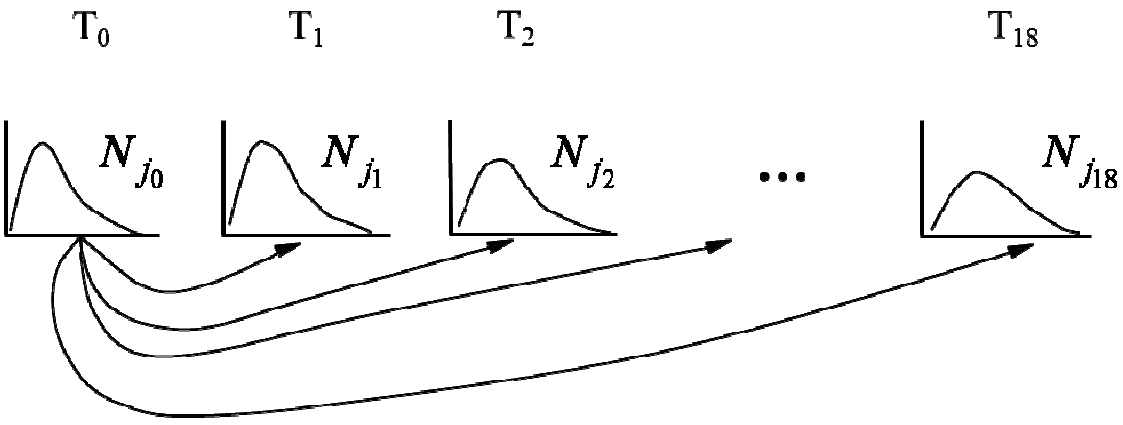


Figure 7: Growth projection sequence to generate monthly stratum population length frequencies.

The operating model temporal sequence was as follows:

1. Initialise home populations:
   - Initialise Length Frequencies for the eight Home strata;
   - Apply growth transition matrix to on-grow Home-strata populations across the 18 monthly recovery time steps;
   - Move fish from Home strata according to movement model to derive actual combined stratum distributions.

2. Tagging process:
   - Random draw (with replacement) a tag release shot.
     For each tagged fish assign:
     - length from release shot;
     - Home stratum status (based on home population ratios in each stratum);
     - survival status (survival probability based on release shot details);
     - growth path and determine future length at each monthly time step (random draw of μ_α and μ_β).
   - Repeat process until target number of releases achieved.

3. Monthly catch examination process:
   - Calculate the actual stratum population length frequency distributions for the given month by applying the movement probability matrix to the month home population length frequencies.
   - Randomly draw (with replacement) a scanned catch. Repeat draws until monthly stratum catch target is attained then sum the length frequencies of all drawn landings.

   - Step through all surviving tagged fish individually (Appendix 8); likelihood of recovery determined by:
     - Probability of being in stratum (defined by movement probabilities ψ);
     - Probability of being in scanned catch (being the proportion the total number of fish in the combined landings represents of the total number of fish currently in that stratum; the probability ratio being specific to the tagged fish's current length (remove fish from survival list if recovered).

   - Repeat process for each successive month.

4. Output observational tagging data:
   - Individual tagged fish release details including its survivorship probability;
   - Scanned landing length frequencies by month, method, and stratum;
   - Individual recovered tagged fish details: length at tagging, length at recovery, landing, stratum, and month.

2.4 Estimator model dynamics

2.4.1 Home fidelity parameterisation and likelihood.

The estimator model was configured to have the same home fidelity dynamics as the operating model.

The basic terms in the estimator model are the same as those given for the operating model given in section 2.3.5.2. The negative log likelihood of observing a given number [*obs*] of *j* tags in stratum *k* over the recovery period (Δt) can be approximated by the binomial distribution given by:

$$\text{-Loglike}(\theta, \text{Rec}[obs]_{jk_{\Delta t}}) = -\sum_{j=1}^{n}\sum_{k=1}^{n}\log(\text{P}\left[\text{Rel}_{jk_{\Delta t}}\right])\text{Rec}[obs]_{jk_{\Delta t}} + \log(1-\text{P}\left[\text{Rel}_{jk_{\Delta t}}\right])(C_{k_{\Delta t}} - \text{Rec}[obs]_{jk_{\Delta t}})$$

Estimable parameters in the model were:

H_x The number of fish that consider stratum *x* as home (cryptic population)
and

ψ Matrix of instantaneous movement probabilities (P[*xj*]).

Using these parameters and the functions given in section 2.3.5.2 the estimator could derive values for the parameters of interest:

N_{j_t} Total number of actual fish in stratum *j* at the time of tagging i.e. t = 0.

and

P_{jk_t} the proportion of the actual number of fish tagged *j* present in stratum *k* at any future time t^l (i.e. $t > 0$).

2.4.2 Growth over the 18 month recovery period

The estimator was required to provide an estimate of the population recruited (length greater than 25 cm) biomass and numbers at the time of tagging (t=0). To do this the estimator needed to account for the change in the length frequency of tagged and untagged fish during the 18 month recovery period. Specifically, this involved back adjusting the length frequency distributions of monthly examined catches (n_2 Appendix 1) to the time of tagging. The length of the recovered tagged fish and all those released (n_1 and m_2 Appendix 1) were known relative to the time of tagging and no growth adjustment of these data was necessary.

2.4.2.1 Growth parameter estimation using tag growth increment observations (GROWTAG after Francis 1988)

Growth increment observations of recovered tagged fish were fitted in the estimator model to estimate the parameters of the exponential growth model (Appendix 3).

[1] Because the ψ matrix, defining the spatial probability distribution of the cryptic populations, does not change through time (i.e. it is an equilibrium matrix) the spatial distribution of tagged fish after tagging likewise do not change (i.e. the actual spatial tag distributions are also equilibrium distributions).

The estimator incorporated a growth increment model (GROTAG) as described in Francis (1988). The Francis (1988) GROWTAG model had the following estimable parameters:

μ_α	the mean annual increment for a fish of length α =25
μ_β	the mean annual increment for a fish of length β =40
θ	the amplitude of the seasonal growth limitation effect
ω	the phase of the seasonal growth limitation effect
σ^2	variance parameter term (Appendix 3)
s (cm)	measurement_error
m (cm)	measurement bias
p	Outlier contamination term

An exponential growth function (Appendix 3) was used in the modified GROWTAG model instaed of a linear increment growth model used by Francis (1988) in the original GROWTAG. The growth log likelihood term used by the estimator is also given in Francis (1988). No priors were specified on the estimated parameters as they were assumed to come from uniform distributions.

2.4.2.2 Estimator length stratification

The operating model tag-release process resulted in a heterogeneous distribution of tags across the length range of the adult population typical of what would occur in an actual SNA 1 tagging programme. To account for this the estimator needed to provide length stratified estimates of population numbers and biomass. The ideal approach would be to stratify the analysis down to the level of the individual 1 cm length bin. However, the number of tag recoveries needed to achieve this level of stratification means that this will probably be an impractical option for a future SNA 1 tagging programme. The tractable compromise was to stratify the analysis into nine length bins; with a greater number of bins near the mode of the population length distribution. The bins used were: 10–24; 25–26; 27–29; 30; 31–32; 33–34; 35–39; 40–44; and 45–100 cm.

2.4.2.3 Biomass estimation

The estimator could provide estimates of stock biomass using its population length frequency estimates and a length weight relationship (Ministry of Fisheries 2008). Although the estimator could provide estimates of the number of fish in each length bin, the relative length composition within each length bin was unknown (for example the length frequency distribution of the 45–100 cm length bin). The estimator therefore had to use the combined length frequency from the scanned longline catches as a relative proxy for the within length-bin length frequency. The assumption behind this was that longline selectivity is relatively uniform and therefore longline catches are representative of the underlying stock length composition.

2.4.2.4 Growth back projections

The estimator was required to back project the examined catch length frequencies to T_0 the time of initial tag release. This was accomplished using a growth back projection matrix (as opposed to a forward project matrix as used by the operating model). The estimator was able to generate the correct back projection matrix by first generating the forward projection matrix using the estimated growth parameters then finding the transpose of this matrix and then re-normalising the row elements so that they summed to one, i.e. represented a density.

As illustrated in Appendix 3, the growth projection of a single length cohort distributes it across multiple length cohorts; the growth projected population length frequency distribution (Figure 8) is the cumulative result of the individual cohort projections.

Back projection of the forward projected Hauraki Gulf population length frequency did not perfectly match the original distribution (Figure 8). The requirement to project across integer length bins is the main reason for the less than perfect transposition, the transposition errors increase with decreasing length because the projection spread of these classes is largest (Figure 8). Also a certain proportion of fish in the smaller length classes are back projected below the starting length bin (15 cm; Figure 8); back projection below 15 cm accounts for most of the loss of fish in the sub-25 cm length range.

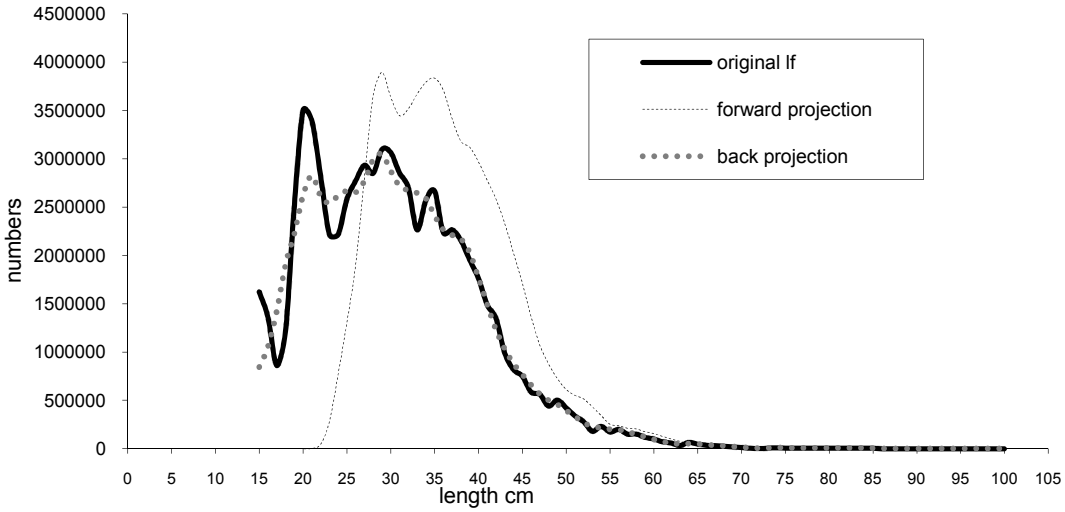


Figure 8: **Forward and back annual growth projection of Hauraki Gulf population length frequency distribution (α = 25; β =40; μ_α = 5.47; μ_β = 2.89; u = 1; w = 0.8; σ^2 = 0.4).**

Although the operating and estimator models forward and back growth projection processes resulted in the loss of fish smaller than 25 cm the total population retained above 25 cm after forward and back projection was very close to 100% (Table 5). We deem therefore that although the estimator and operating model growth projection steps would have contributed to variation in the estimation process the projections were unlikely to bias the overall estimates at least for the proportion of the population above 25 cm.

Table 5: Percentage differences between the original Hauraki Gulf population length frequency by numbers and weight (biomass) after a forward and back annual growth projection.

Length range	Initial	Fwd Proj	Back Proj	% initial lf	% initial wt
all	72 843 328	7 2843 324	71 622 562	98.32%	100.00%
<25	21 727 372	1 099 304	20 674 747	95.16%	98.59%
>25	**51 115 956**	**71 744 020**	**50 947 814**	**99.67%**	**100.20%**
25–26	5 355 953	3 215 078	5 318 571	99.30%	99.09%
27–29	8 881 134	10 355 307	8 811 033	99.21%	99.33%
30	3 065 459	3 637 563	2 874 205	93.76%	93.76%
31–32	5 559 444	6 961 244	5 390 233	96.96%	97.04%
33–34	4 833 145	7 459 277	5 238 377	108.38%	108.06%
35–39	11 278 269	17 255 060	11 085 591	98.29%	98.70%
40–44	6 418 070	12 687 250	6 402 073	99.75%	99.91%
45–100	5 724 482	10 173 240	5 827 731	101.80%	101.42%

2.5 SNA 1 Tagging programme investigated design scenarios

2.5.1 3 and 8 spatial area programme designs options

Two spatial designs were investigated:

- Eight explicit spatial areas corresponding to operating model stratification
- Three spatial strata corresponding to east Northland, Hauraki Gulf, Bay of Plenty (Table 1).

It was anticipated that the three spatial area programme design would be less expensive than the eight because there were significantly fewer estimable parameters (136 compared with 41, see Table 6). However, the three-area design was incapable of correctly accounting for movement and the spatial mark-rate heterogeneity inherent in the data.

Table 6: Number of estimable parameters corresponding to eight and three stratum designs.

	Number of strata (n)	
Parameters	8	3
GROWTAG	8	8
Movement matrix ($\Psi = n^2-n$)	56	6
Home stratum (x) length bin (l) population ($H_{xl} = 9 \times n$)	72	27
Total	136	41

2.5.2 Estimator model inputs

The operating model provided the estimator with the following basic inputs (refer Appendix 1):

- n_1 the total length frequency of all tagged fish released by spatial stratum
- n_2 the length frequency of all fish examined for tags by stratum by month

- m_2 a set of tagged fish recovery details (release and recovery stratum; release and recovery lengths).

The estimator made no explicit adjustment for initial mortality. The release length frequency data generated by the operating model were summations of the individual tagged fish survivorship probabilities.

The operating model aggregated the data to the spatial level required by the estimation scenario i.e. eight or three spatial strata.

2.5.3 Model fitting and parameter estimation

The estimator model was constructed in AD Model Builder software (www.admb-project.org) and used an auto-differentiation minimiser to find the parameter space corresponding to the optimum negative log-likelihood. The estimator has two likelihood terms: the GROWTAG growth model to tag growth-increment observations (section 2.4.2.1) and a binomial likelihood for fitting the observed number of tag recoveries (section 2.4.1). Because the growth transition matrix is critical to deriving the expected number of tag recoveries, the estimator first obtained an optimal GROWTAG fit to the tag growth increment data before proceeding to fit the tag recovery data.

2.5.4 The nine cell grid design matrix

Overall the precision on the tagging biomass estimates is directly proportional to the number of tags recovered. To achieve a given number of recoveries the options are either to release a large number of tags or to release fewer tags and examine more catch. The trade-off between tag release and catch examination were investigated as a cost-optimisation of designs that could achieve a predetermined number of tag recoveries.

Nine tagging designs were evaluated based on a combination of three levels of tag releases (15000; 30000; 60000) and three proportions of the total SNA 1 commercial catch examined (0.9; 0.6; 0.3).

Tags were allocated strata as per the relative proportions given in Figure 6 with 80% being assigned to longline and 20% to trawl release methods. The amount of catch examined in each of the 13 recovery months by method and stratum were established as direct scaled proportions of the total catches given in Appendix 4.

2.6 SNA 1 tagging programme design cost optimisation

The costs for the programme are based on using Passive Integrated Transponder (PIT) tags (McKenzie et al. 2006) and scanners.

The cost optimisations were conducted solely on the basis of design variable cost items (Table 7).

Programme fixed cost components (preparation time, release design and release logistics; scanner purchase; recovery phase management; data processing; analysis and report production; catch sampling to estimate untagged fish growth and to described the length composition of the examined catch; and off-shore onshore spatial CPUE analysis) are difficult to predict as it is unknown how much of the cost will be borne by the fishing industry. We have assumed the likely range for fixed costs to be 2 to 2.5 million. For the purpose of coming up with a final indicative set of costs we have used 2.5 million as the fixed cost component (Table 7).

Table 7: **Assumed costs (2009 $NZ dollars exclusive of GST) for programme variable and fixed cost components.**

Cost item	Unit cost
PIT tag	$3
Longline tag set	$1 250
Trawl tag shot	$1 500
Scanned landing	$500
Assumed total fixed costs	$2 500 000

The number of expected tag recoveries associated with each of the nine release and recovery designs was represented as a three-dimensional surface plot or matrix, the two dimension axes being release and recovery cost; an appropriate surface function ($f(x,y)$) was then fitted to this matrix (least squares fit). The fitted surface function was used to generate an expected number of tag recoveries ($E[T_{rec}]$) for a given release cost (x) and recovery cost (y), i.e. $E[T_{rec}] = f(x,y)$.

The following likelihood function was used to find the optimum release and recovery strategy i.e. optimum cost ($x + y$) for a given number of recoveries:

$$-\text{Loglike}(\theta, x+y) = -\log\left[\left(T_{rec} - f(x,y)\right) + \sqrt{x+y}\right]$$

2.7 Bootstrap simulation process

In summary; two SNA 1 tagging programme spatial design options were investigated (three and eight area designs). Nine release and recapture design scenarios were undertaken for each spatial design for the purposes of determining the optimum combination of release and recapture costs. Furthermore two full sets of simulations were undertaken: one each for homogeneous and heterogeneous tag releases. In total 36 individual bootstrap design scenarios were investigated.

The operating model generated 1000 stochastic sets of observational data for each of the 36 scenarios. These data observations were then passed to the estimator which generated the best maximum likelihood parameterisation for each bootstrap data set.

Scenarios were compared on the basis of root mean square error (RMSE) and proportional bias on the population biomass and other parameters of interest (Appendix 9).

3 RESULTS

3.1 Tag observational data fits (homogeneous releases)

3.1.1 Three recovery strata

The estimator under all design scenarios achieved excellent overall fits to the tag recovery observations; there was little contrast in the overall coefficient of variation (c.v.) across the design range (Table 8).

Table 8: Mean number of tags observed and expected tags generated by the simulations.

	Tag	Tag recoveries		
Catch %	releases	*obs tags*	*exp tags*	c.v.
90%	60 000	2 617	2 617	0.012
90%	30 000	1 339	1 339	0.015
90%	15 000	701	701	0.018
60%	60 000	1 807	1 807	0.014
60%	30 000	925	925	0.017
60%	15 000	484	484	0.021
30%	60 000	1 000	1 000	0.016
30%	30 000	511	510	0.021
30%	15 000	268	268	0.028

The model fits to the tag movement observations between the three recovery strata (corresponding in this example to east Northland, Hauraki Gulf and Bay of Plenty) were relatively unbiased for all tagging designs (Figure 9). As would be expected the precision on the tag fits increased with increasing tag recoveries however the estimator still had trouble (lower precision) fitting tag recovery observations that pertained to or interacted with east Northland (stratum 1; Figure 9).

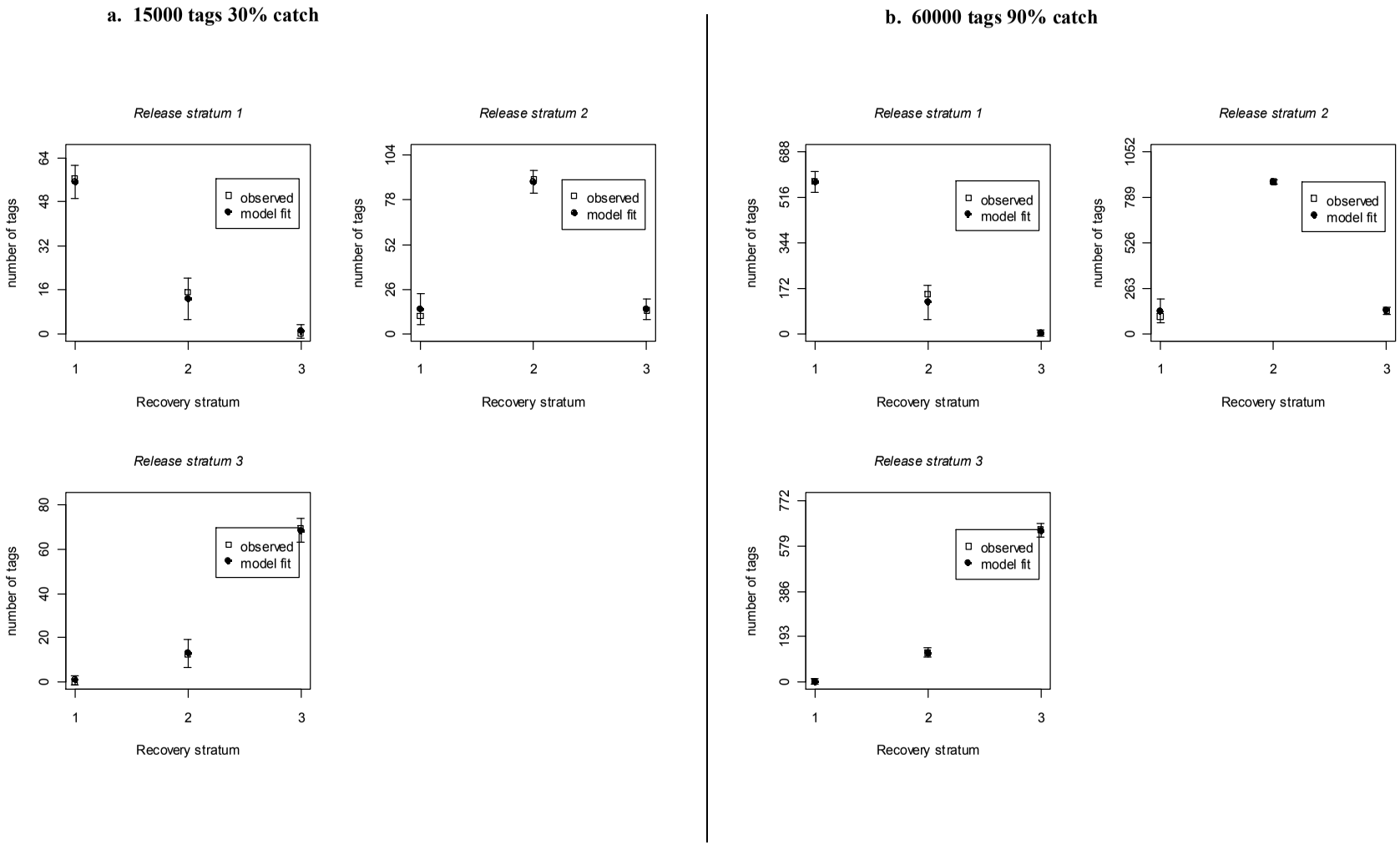


Figure 9: **Estimator fits to observed tag movement relative to release and recovery areas for the least costly and most costly tagging designs**

3.1.2 Eight recovery strata

The match to the overall number of observed tags in the eight stratum design was also excellent (Table 9) with only marginally better precision than the three stratum simulations (Table 8).

Table 9: Mean number of tags observed and expected tags generated by the simulations.

	Tag	Tag recoveries		
Catch %	releases	*obs tags*	*exp tags*	c.v.
90%	60 000	2 617	2 617	0.014
90%	30 000	1 341	1 341	0.019
90%	15 000	701	701	0.025
60%	60 000	1 807	1 807	0.016
60%	30 000	926	925	0.022
60%	15 000	484	483	0.029
30%	60 000	999	999	0.021
30%	30 000	510	510	0.028
30%	15 000	267	267	0.038

The estimator achieved very good fits to the tag movement observational data across all eight strata (Figure 10).

3.2 Growth estimation

All the investigated designs produced relatively unbiased and precise growth parameter estimates which directly translate to similar level of fidelity in the growth transition matrices (see growth parameter tables in Appendix 10 and Appendix 11). The results suggest relatively few tag recoveries are needed to estimate growth, meaning that growth estimation is unlikely to be a limiting factor in future tagging programme designs.

3.3 Population numbers and biomass estimates (homogeneous base-case)

3.3.1 Population estimates by length-bin

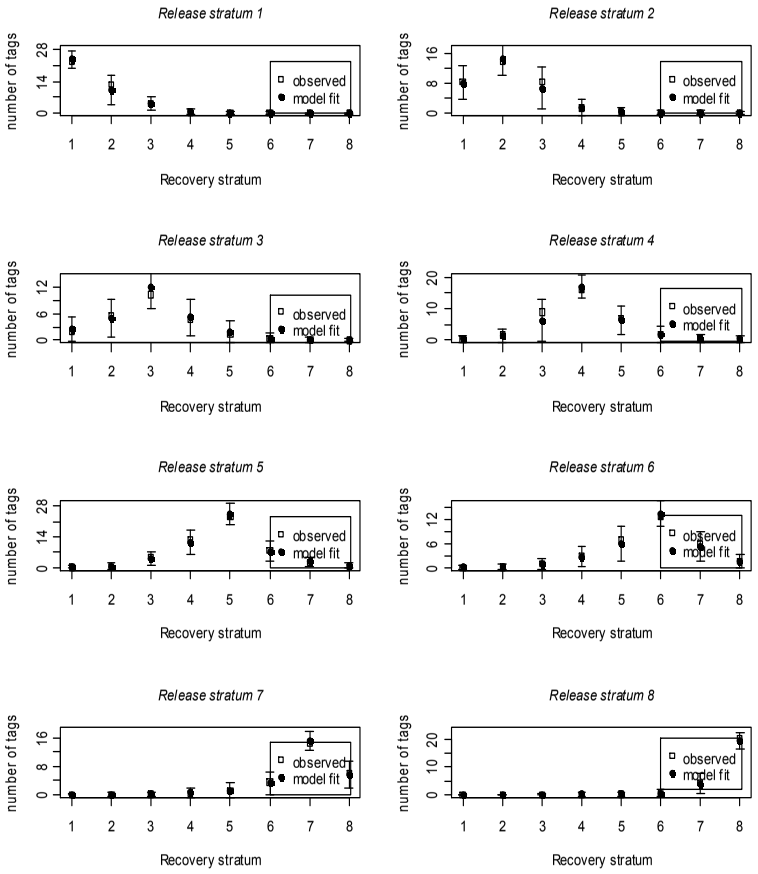
The three and eight stratum designs were both capable of achieving reasonably precise and accurate population estimates over most length bins for the highest tag release and examination scenarios (Appendix 10i ; Appendix 11i). For all model runs the exception to the otherwise accurate population estimates was the first length bin (15–24 cm). Estimates for this length bin in all model runs were consistently underestimated (Figure 11). Biased estimates in the smallest length bin were likely as a consequence of the fish being lost from the bin under growth back projection (Section 2.4.2.4) and was the reason why the 15–24 cm length bin was included in the estimator design. The 15–24 cm length bins were excluded from all the population analyses that follow; the purpose of the simulations being to evaluate estimator performance in relation to the recruited (greater than 25 cm) fraction of SNA 1, i.e. we are not concerned about bias in the 15–24 cm length category.

3.3.2 Biomass estimates by length-bin

Again the three and eight stratum designs were both capable of achieving reasonably precise and accurate biomass estimates for most length bins at the highest tag release and examination scenarios

(Appendix 10i; Appendix 11i). Although the population number estimates for the largest length bin (greater than 45 cm) were relatively unbiased (Figure 11; see also tables in Appendix 10i) the biomass for this bin was consistently under-estimated across all designs and release scenarios (Figure 12); see also tables in Appendix 10i). The biomass underestimate is mostly an artefact of using the observed longline catch length frequency as a proxy for the length-bin length frequency. The largest length bin is broad (45–100 cm) and composed of large heavy fish; mismatches between the longline sample length frequency and the population length frequency are likely to account for the bias in the biomass estimates for this length category.

a. 15000 tags 30% catch



b. 60000 tags 90% catch

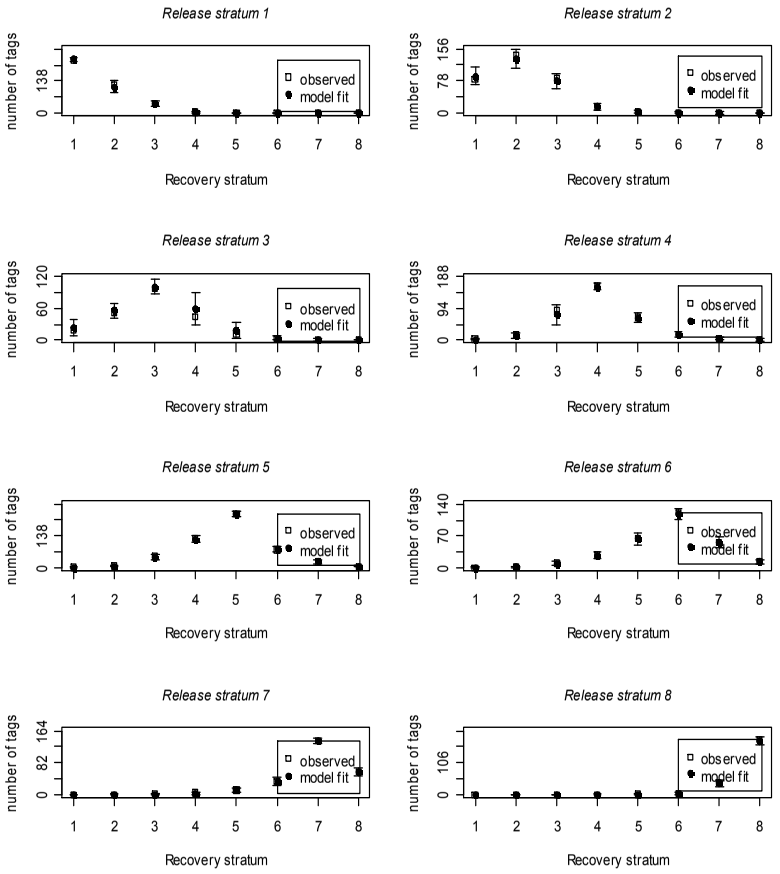


Figure 10: Estimator fits to observed tag movement tag movements relative to release and recovery areas for the least costly and most costly tagging designs.

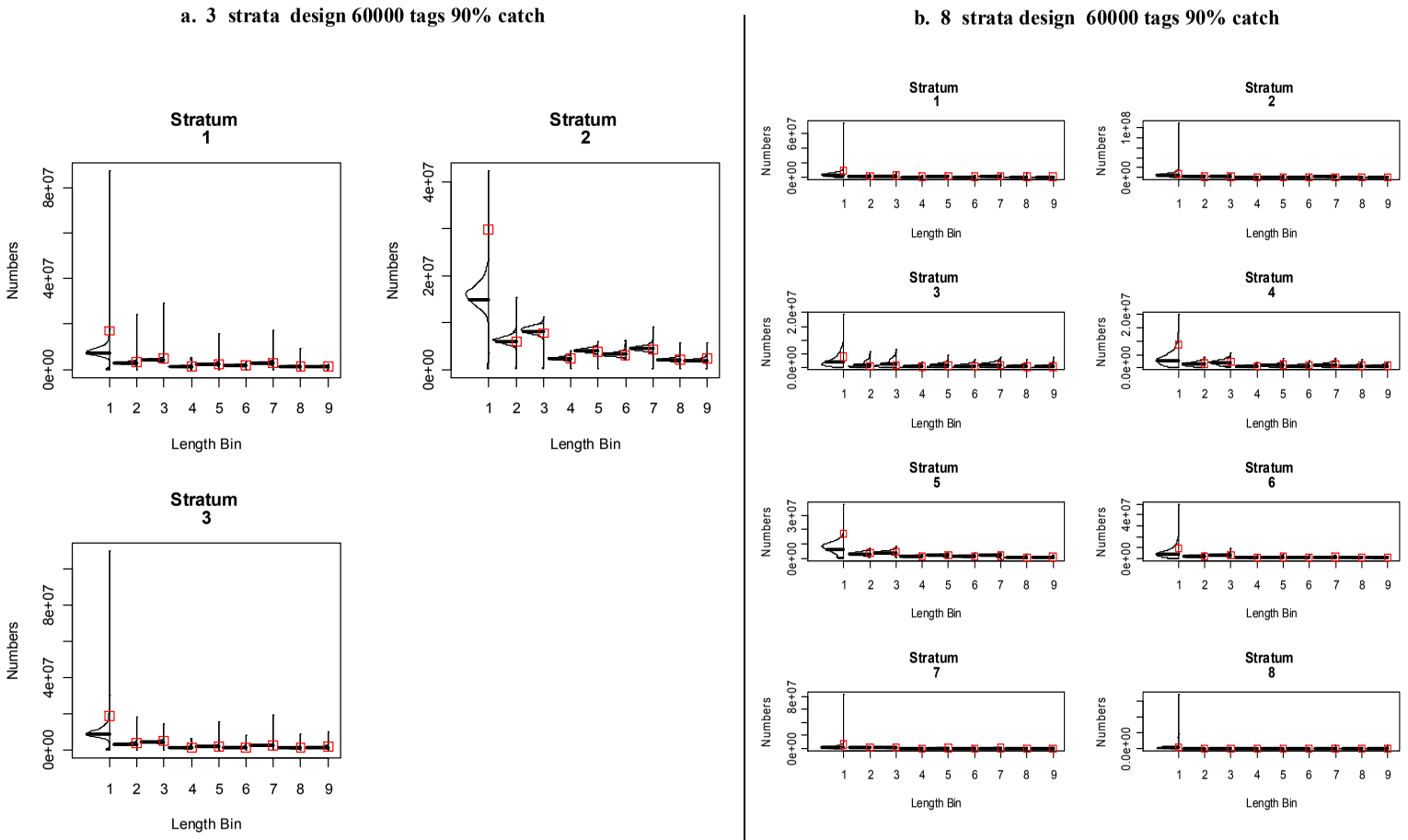


Figure 11: **Population estimates by stratum and length bin for three and eight stratum designs generated under a maximum tag release and catch examination scenario; squares denote operating model values.**

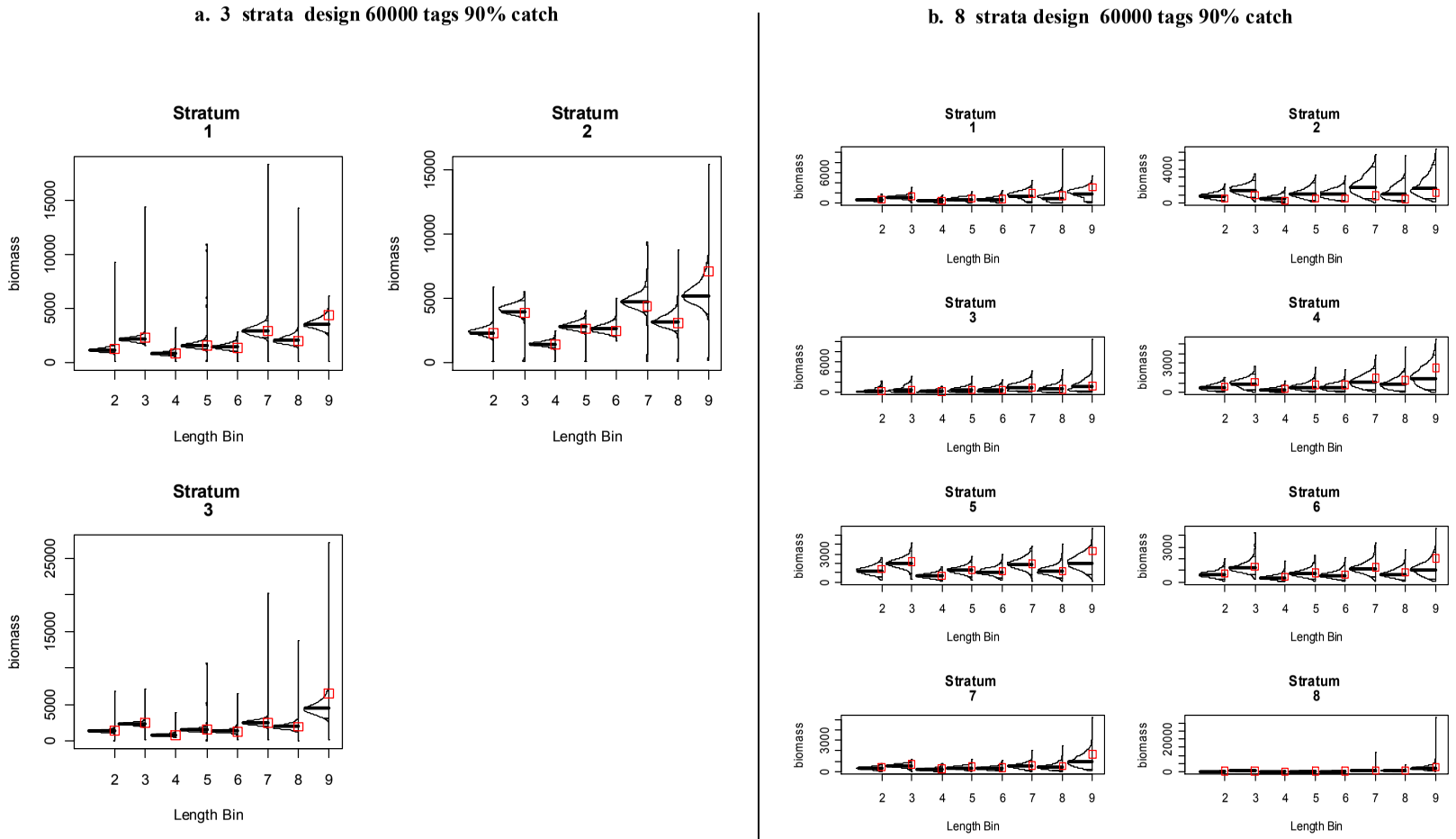


Figure 12: **Biomass estimates by stratum and length bin for three and eight stratum designs generated under a maximum tag release and catch examination scenario; squares denote operating model values.**

3.4 Stock-stratum population and biomass estimates

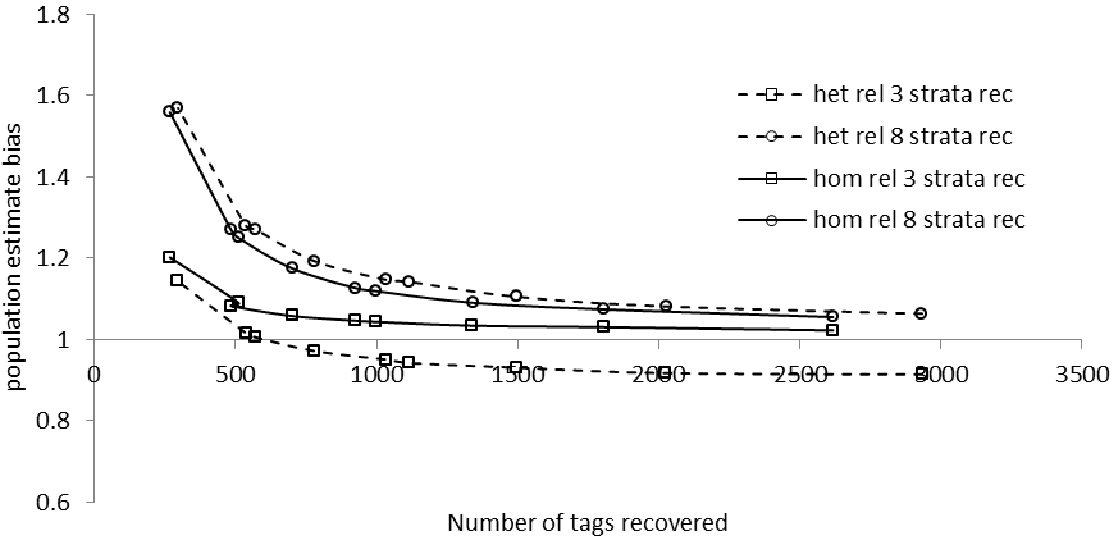
3.4.1 Estimate bias

One way to evaluate how well the various tagging designs performed against underlying heterogeneity and homogeneity in tag spatial distribution is to compare estimation bias.

3.4.1.1 SNA 1 estimation bias

The estimator model bias on the estimates of overall SNA 1 population numbers and biomass were within plus or minus 10% for all designs yielding greater than 2000 overall tag recoveries (Figure 13).

a. Population numbers



b. Biomass estimates

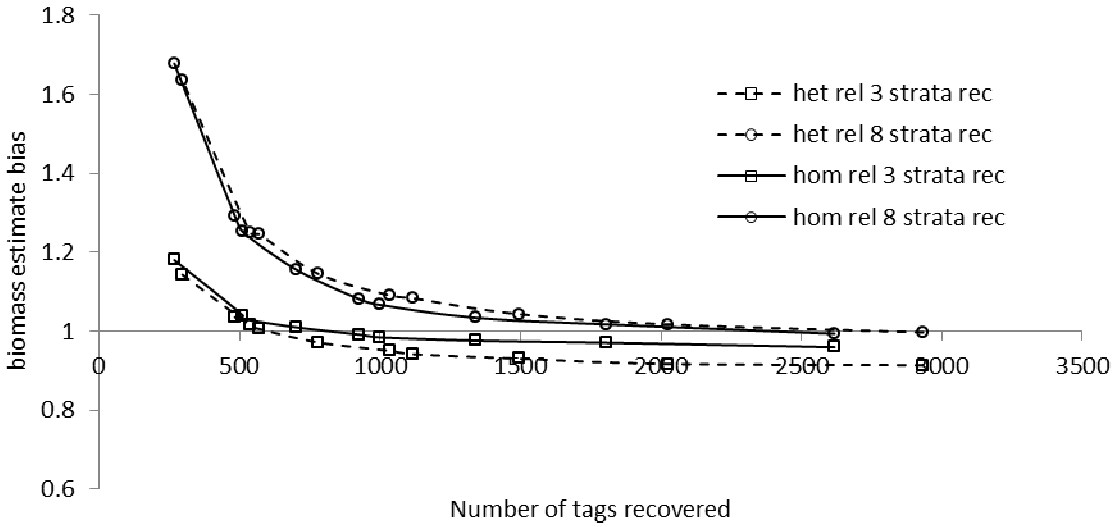


Figure 13: **Estimator bias design specific comparative plots for SNA 1 under homogeneous and heterogeneous mixing dynamics and three and eight stratum designs.**

The eight stratum designs were more robust to underlying mark-rate heterogeneity, indications being that the eight stratum design would eventually converge on an unbiased estimate, albeit at very high tag recovery numbers (greater than 3500; Figure 13). However, at tag recovery levels of less than 1500, the three stratum designs were less biased than the eight stratum designs (Figure 13) under both homogeneous and heterogeneous mixing conditions. The three stratum design was only marginally more biased than the eight stratum design at tag recoveries between 1500 and 2000 under heterogeneous mixing conditions (Figure 13).

3.4.1.2 East Northland estimation bias

Consistent with the overall SNA 1 bias plots, a three stratum design under homogeneous tag release produced the least biased east Northland population estimates (Figure 14). An eight stratum design was only marginally less biased than the three stratum design for population numbers when tag releases were heterogeneous, however, the bias differential on the biomass estimates was more pronounced (Figure 14).

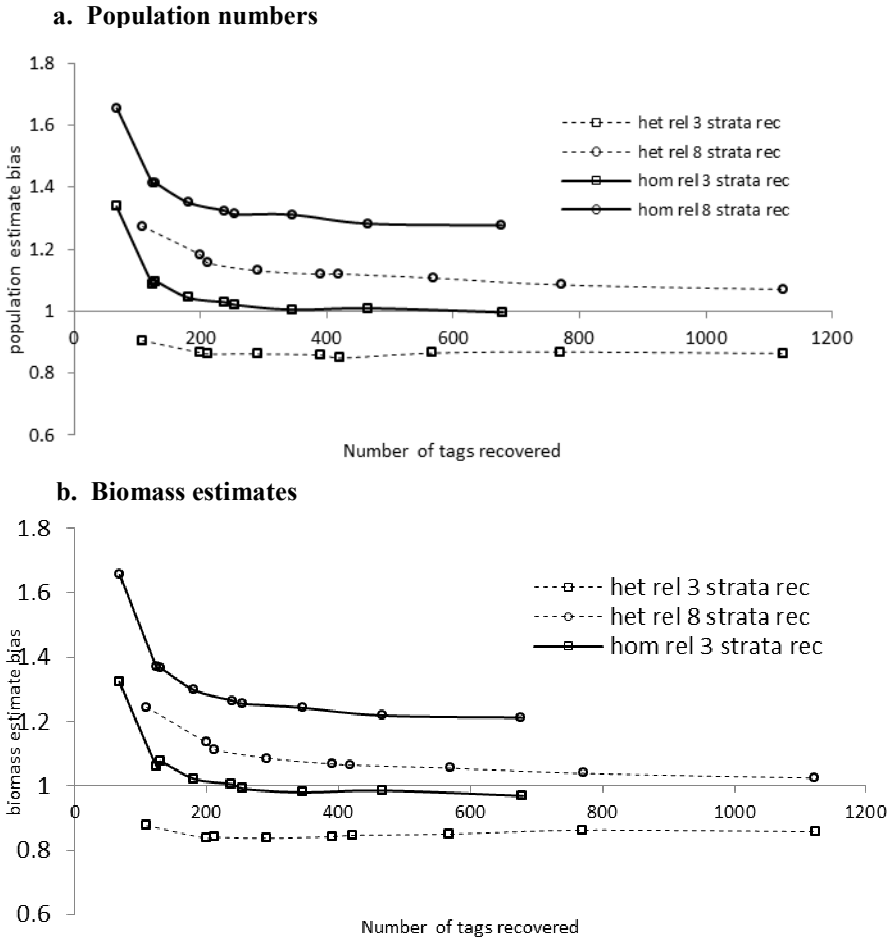
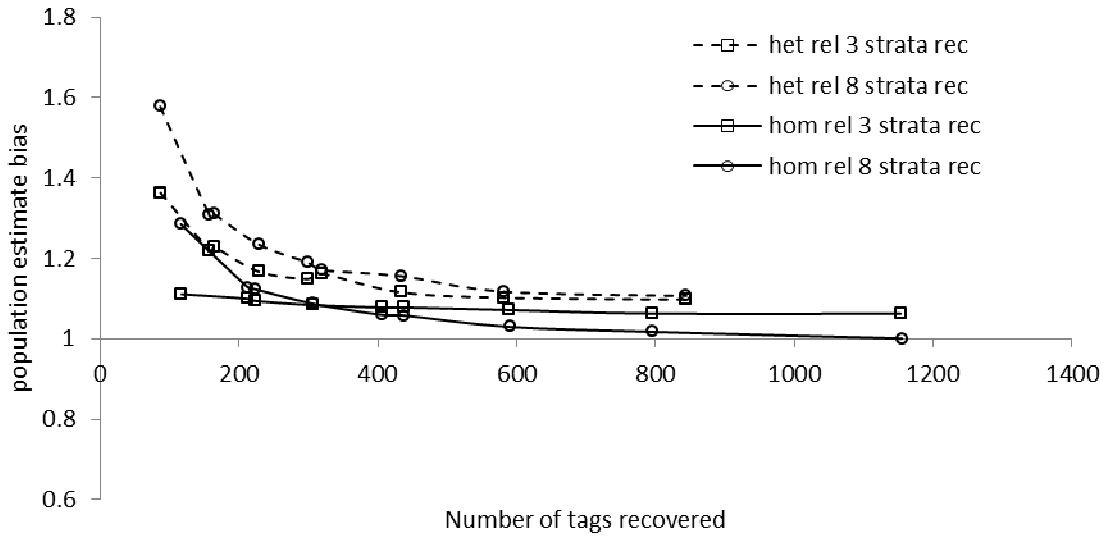


Figure 14: Estimator bias design specific comparative plots for east Northland under homogeneous and heterogeneous mixing dynamics and three and eight stratum designs.

3.4.1.3 Hauraki Gulf estimation bias

There was very little difference in bias between the eight and three stratum designs under either homogeneous or heterogeneous mixing scenarios (Figure 15); both were less biased under homogeneous tag release.

a. Population numbers



b. Biomass estimates

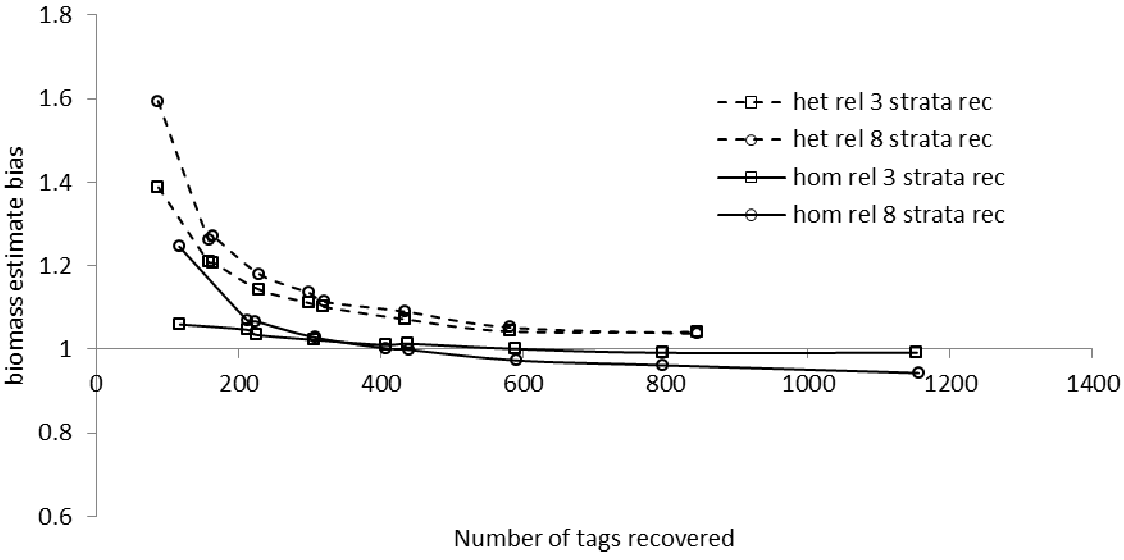
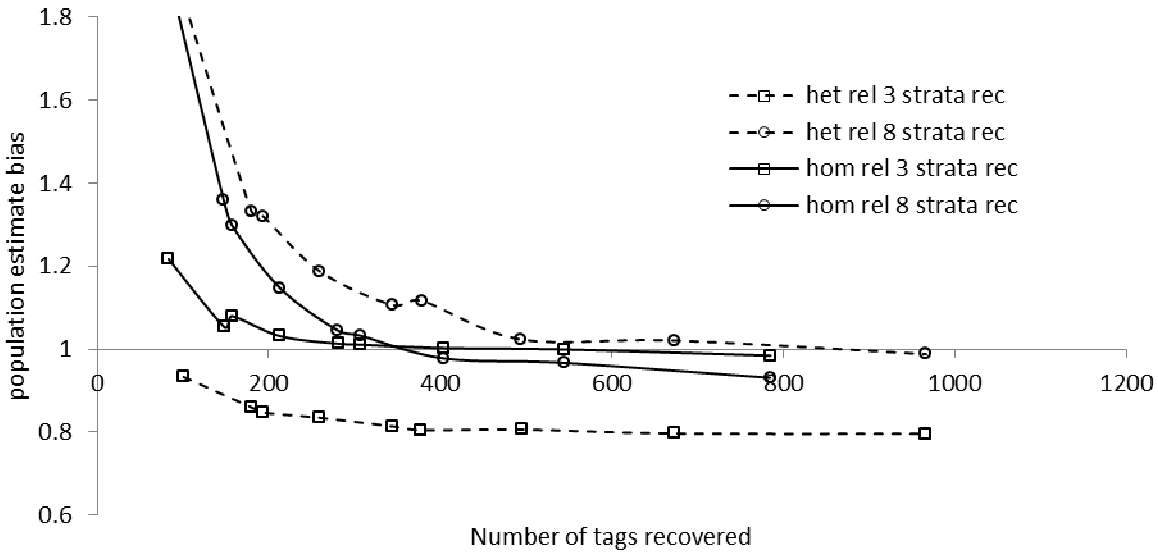


Figure 15: Estimator bias design specific comparative plots for Hauraki Gulf under homogeneous and heterogeneous mixing dynamics and three and eight stratum designs.

3.4.1.4 Bay of Plenty estimation bias

Again consistent with the general pattern seen in the other areas the three stratum design under homogenous tag release produced the least biased estimates over low to moderate tag recovery numbers (200–600; Figure 16). The eight stratum design was significantly less biased than the three stratum design under heterogeneous release conditions (Figure 16).

a. Population numbers



b. Biomass estimates

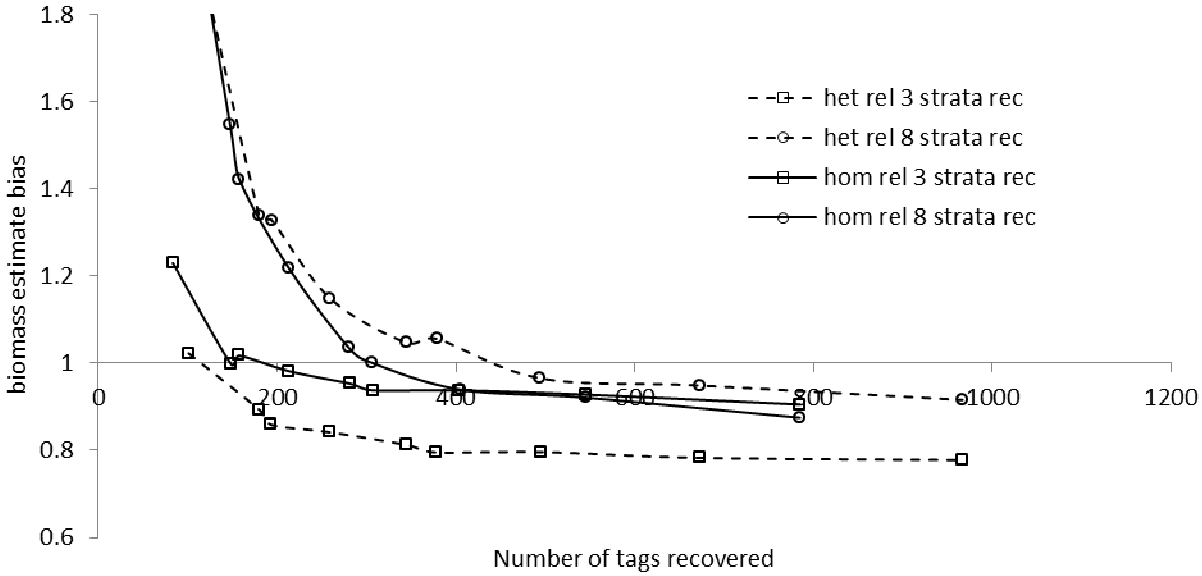


Figure 16: Estimator bias design specific comparative plots for Bay of Plenty under homogeneous and heterogeneous mixing dynamics and three and eight stratum designs.

3.4.1.5 Recommended release strategy to minimise bias

A general conclusion from the bias analysis is that, over low to moderate expected levels of tag recovery, the three stratum design was consistently less biased than the eight stratum design. Indications are that the eight stratum design is more robust to tag spatial heterogeneity but an unrealistically high number of tag recoveries would be required to realise the benefit of increasing design stratification.

The ideal number of target recoveries for a SNA 1 tagging programme can be deduced from the change in slope in the recovery area bias plots. The range over which most of the simulation designs achieved a flat bias trajectory equates overall to between 1500 and 2000 tag recoveries (Table 10).

Table 10: Tag recovery target range over which most of the estimation bias plots achieve a flat trajectory (Figure 13; Figure 14; Figure 15; Figure 16).

Stock area	Lower range	Upper range
SNA 1	1 500	2 000
East Northland	450	600
Hauraki Gulf	600	800
Bay of Plenty	450	600

3.4.2 Estimate precision (c.v.)

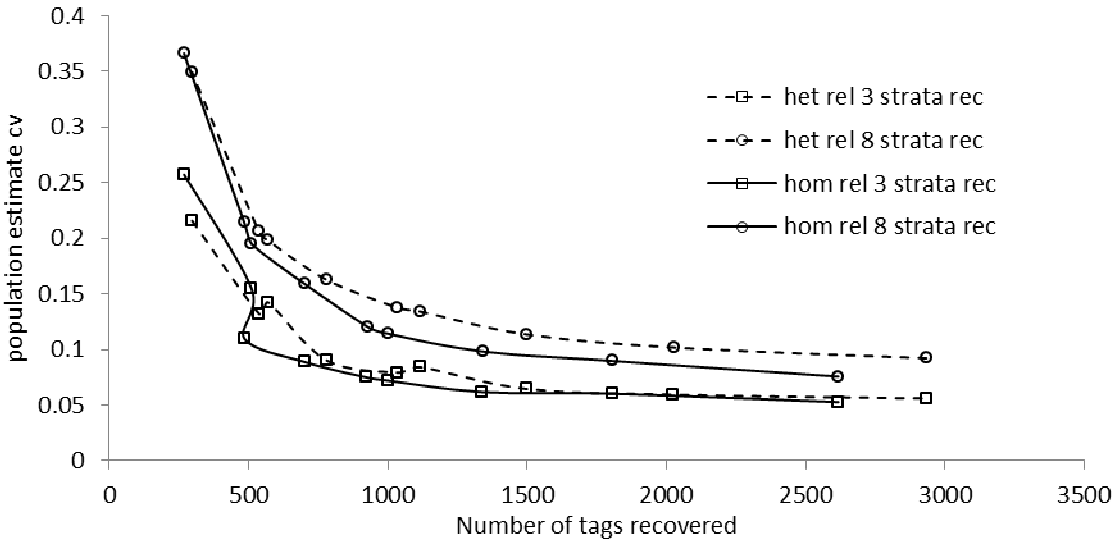
Change in estimate precision (c.v.) offers an alternative look at how well the various tag design scenarios performed relative to each other.

3.4.2.1 SNA 1 estimate precision

The asymptote on the estimate c.v.s under most design and tag homogeneity scenarios was close to 0.1. The three stratum design achieved the optimum c.v. at much lower levels of tag recovery than the eight stratum design (Figure 17). Unlike the bias plots the improvement in c.v. for the three stratum design was similar under heterogeneous and homogeneous mixing conditions (Figure 17).

The asymptote in the c.v. plots indicate that the optimum range of tag recoveries for SNA 1 is between 1000 and 1500 (Figure 17), this being less than required to achieve the optimum reduction in bias (Table 10).

a. Population numbers



b. Biomass estimates

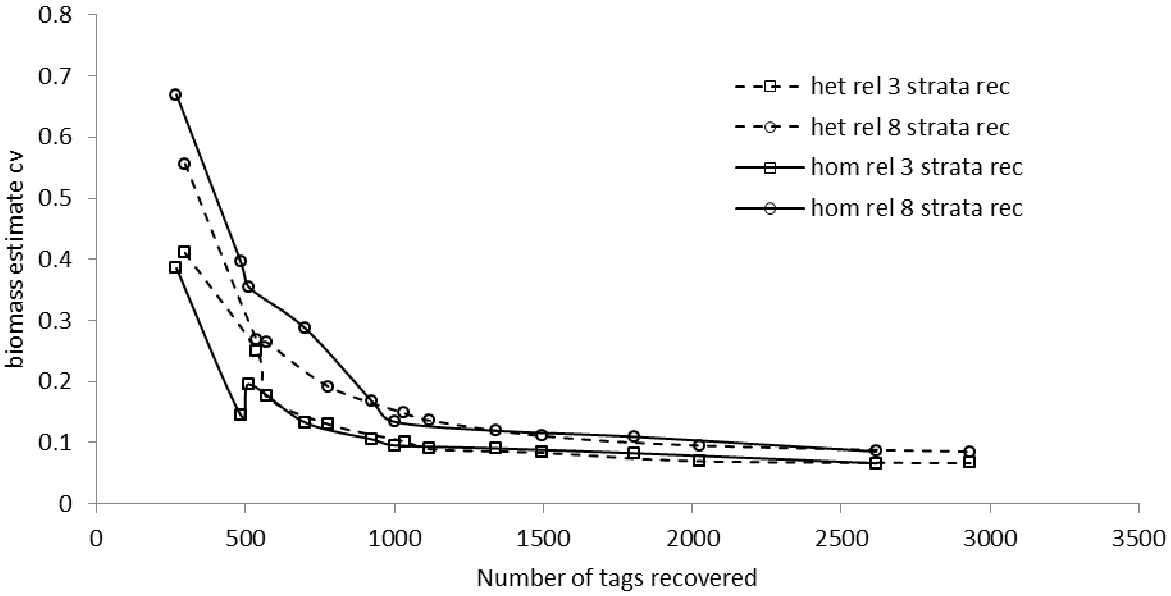


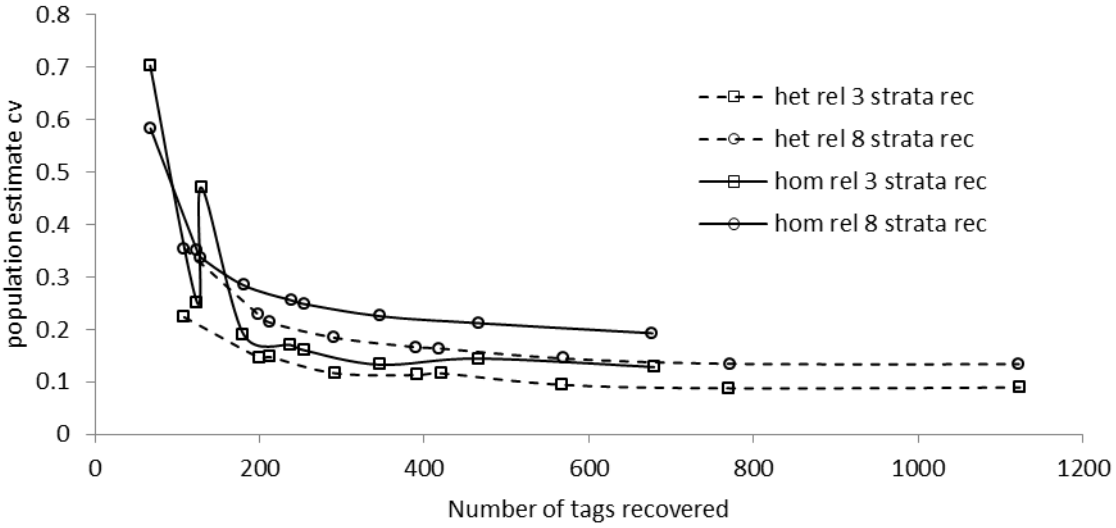
Figure 17: Estimator c.v. design specific comparative plots for SNA 1 under homogeneous and heterogeneous mixing dynamics and three and eight stratum designs.

3.4.2.2 East Northland estimate precision

The pattern in the east Northland estimate c.v.s is similar to that seen in SNA 1 as a whole (compare Figure 17 and Figure 18); but the trend in the c.v.s was more noisy (fluctuating) at low recovery numbers.

The asymptote in c.v. plots indicate that the optimum range of tag recoveries for east Northland is between 300 and 400 (Figure 18), this being less than required to achieve the optimum reduction in bias (Table 10).

a. Population numbers



b. Biomass estimates

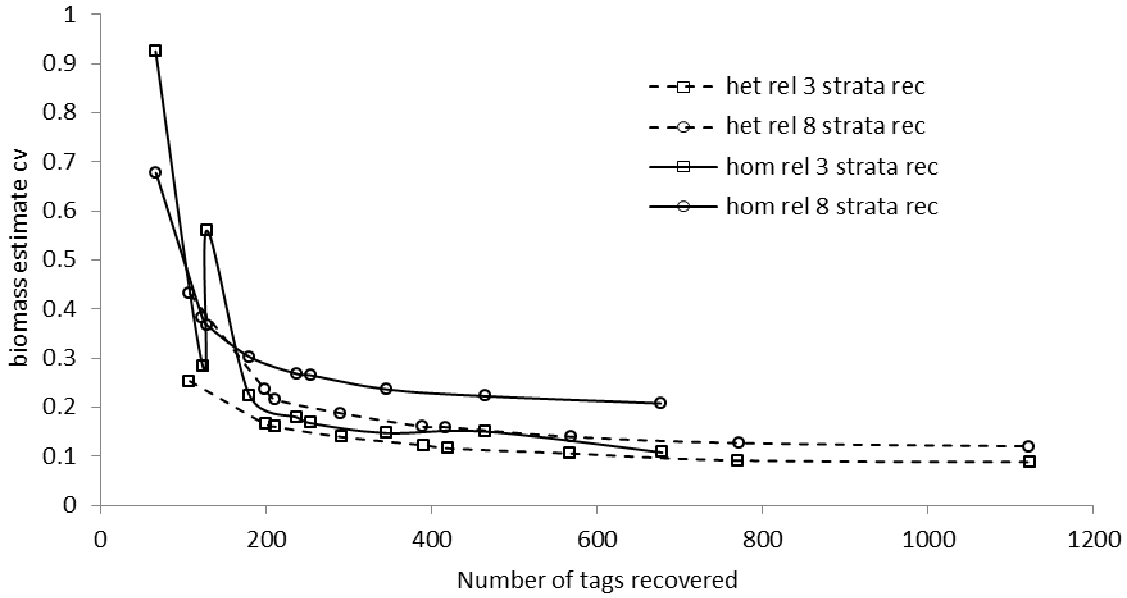
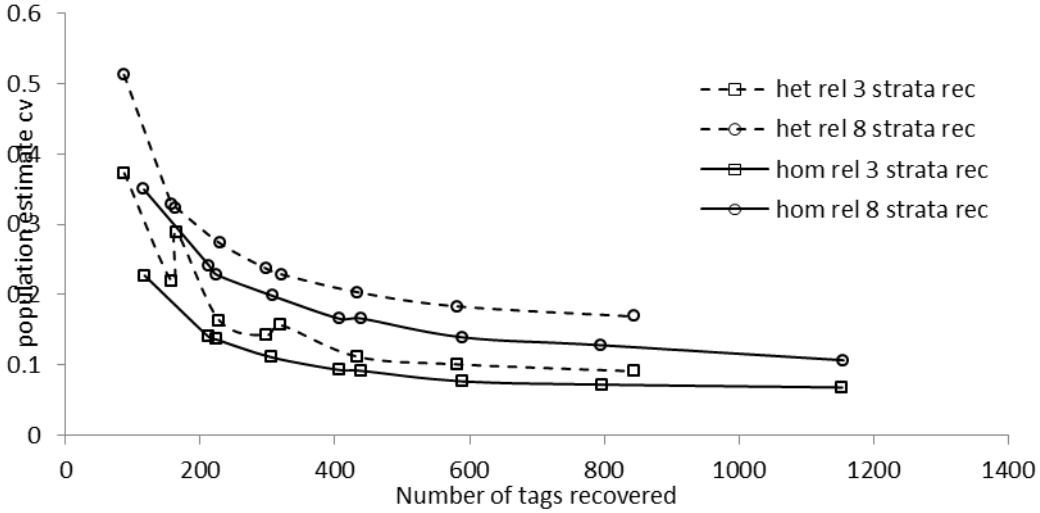


Figure 18: Estimator c.v. design specific comparative plots for east Northland under homogeneous and heterogeneous mixing dynamics and three and eight stratum designs.

3.4.2.3 Hauraki Gulf estimate precision

The asymptote in the c.v. plots indicate that the optimum range of tag recoveries for Hauraki Gulf is between 500 and 600 (Figure 19), this being less than required to achieve the optimum reduction in bias (Table 10).

a. Population numbers



b. Biomass estimates

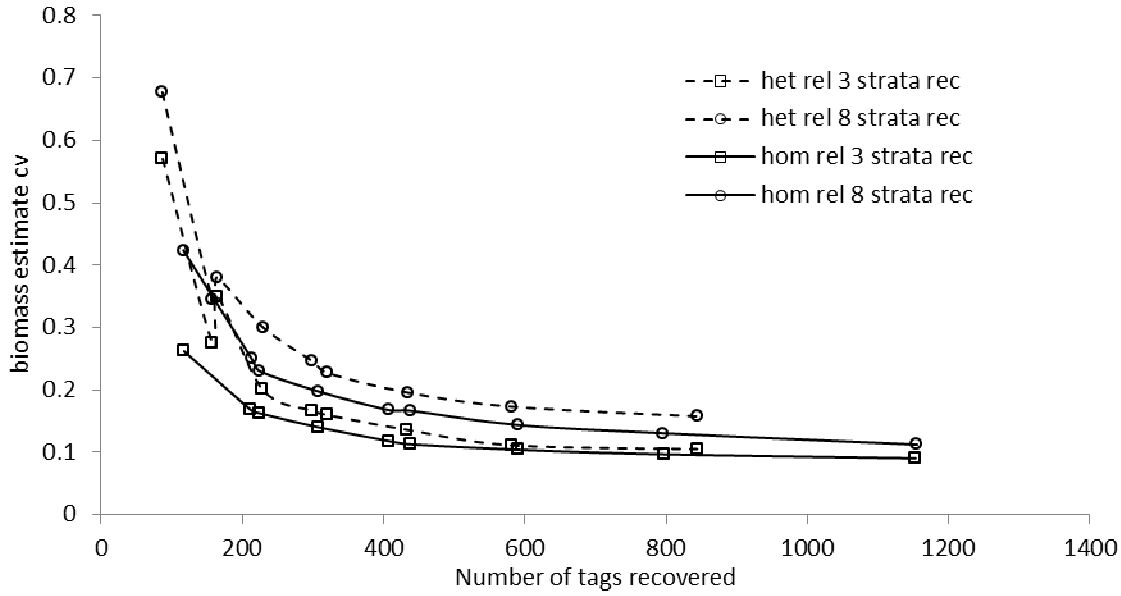
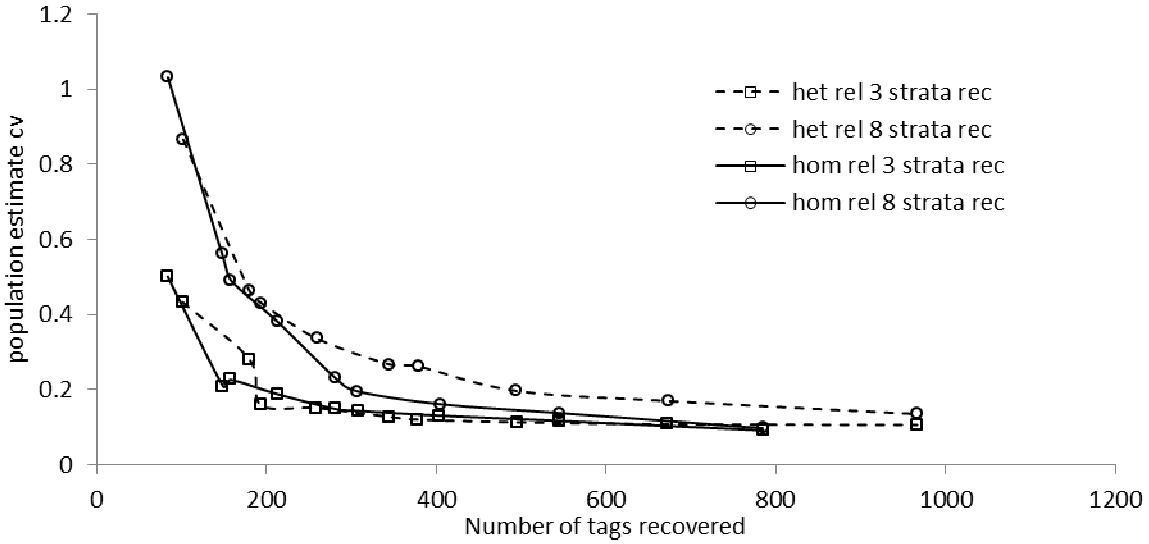


Figure 19: Estimator c.v. design specific comparative plots for Hauraki Gulf under homogeneous and heterogeneous mixing dynamics and three and eight stratum designs.

3.4.2.1 Bay of Plenty estimate precision

The asymptote in the c.v. plots indicate that the optimum range of tag recoveries for Bay of Plenty is between 300 and 500 (Figure 20), this being less than required to achieve the optimum reduction in bias (Table 10).

a. Population numbers



b. Biomass estimates

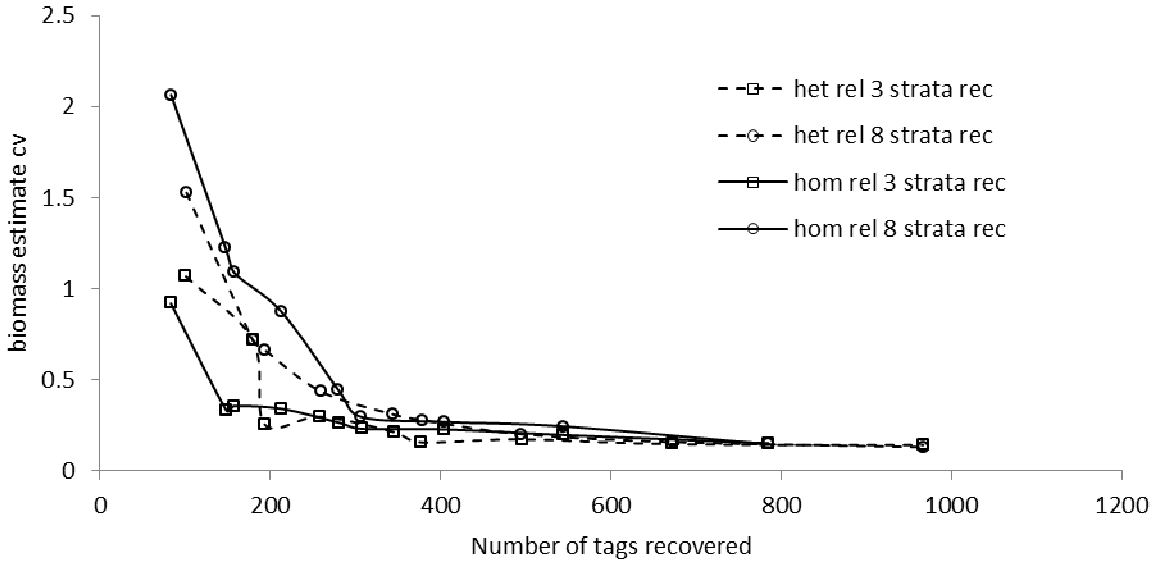


Figure 20: Estimator c.v. design specific comparative plots for Bay of Plenty under homogeneous and heterogeneous mixing dynamics and three and eight stratum designs.

3.4.2.2 Implication on the optimum number of tag recoveries on the basis of precision (c.v.)

The overall conclusion from the precision analysis is the same as that for the bias evaluation; i.e. the three stratum designs achieved overall better precision than the eight stratum designs at lower numbers of expected tag recoveries. The three stratum design under heterogeneous mixing was generally only marginally less precise than under homogenous mixing. The optimum number of tag recoveries, as indicated by the greatest reduction in slope on the precision curves, was always less than the optimum indicted by the bias curves; the conclusion being that designs based on maximum improvement in bias should also achieve the best improvement in precision (c.v.).

3.5 SNA 1 tagging programme design cost optimisation

The bias plots suggest that an eight stratum design under scenarios leading to very high number of tag recoveries (greater than 3500) would be less biased and more resilient to mark-rate heterogeneity than a three stratum design. However the cost of a tagging programme capable of yielding this level of recovery would probably be prohibitive. At recovery levels of between 1000 to 2000 tags, a three stratum design is preferable to the eight. A critical requirement in going with a three stratum design is that the programme achieves a reasonably homogeneous release distribution of tags across SNA 1 in relation to spatial abundance.

Cost optimisations were undertaken on the operating model bootstrap generated costs and tag recovery observed means for the three stratum design under homogeneous tag mixing (Table 11).

Table 11: Operating model bootstrap mean release and examination costs and observed tag recoveries for the three stratum design under homogeneous mixing.

catch exam	target tags	bootstrap mean no. tags released	bootstrap mean no. fish scanned	bootstrap mean release cost	bootstrap mean examination cost	bootstrap mean tags recovered	function $f(x,y)$ pred tags rec
90%	60 000	61 431	4 804 032	$1,729,585	$2,704,984	2 617	2 617
90%	30 000	31 412	4 805 530	$886,674	$2,704,734	1 339	1 335
90%	15 000	16 426	4 802 097	$467,691	$2,704,519	701	701
60%	60 000	61 404	3 322 653	$1,724,592	$1,843,968	1 807	1 810
60%	30 000	31 420	3 321 404	$889,468	$1,844,027	925	930
60%	15 000	16 421	3 320 427	$467,998	$1,843,434	484	487
30%	60 000	61 414	1 840 078	$1,729,736	$983,285	1 000	997
30%	30 000	31 427	1 840 283	$887,198	$983,195	511	509
30%	15 000	16 412	1 842 751	$465,764	$983,621	268	266

The surface function (f(x,y); Figure 21) that gave the best least squares fit of release and recapture costs to bootstrap tag recovery mean was:

$$f(x,y) = a(x^b)(y^c)$$

Where:

x	=	release cost bootstrap mean (Table 11)
y	=	examination cost bootstrap mean (Table 11)
a	=	1.01E-09
b	=	1.006851
c	=	0.953551

The surface function achieved a very good fit to the bootstrap mean recoveries (r2 = 0.999) and provided a good predictive relationship between programme costs and tag recoveries (Figure 21; Table 11).

$$f(x,y) = a(x^b)(y^c)$$

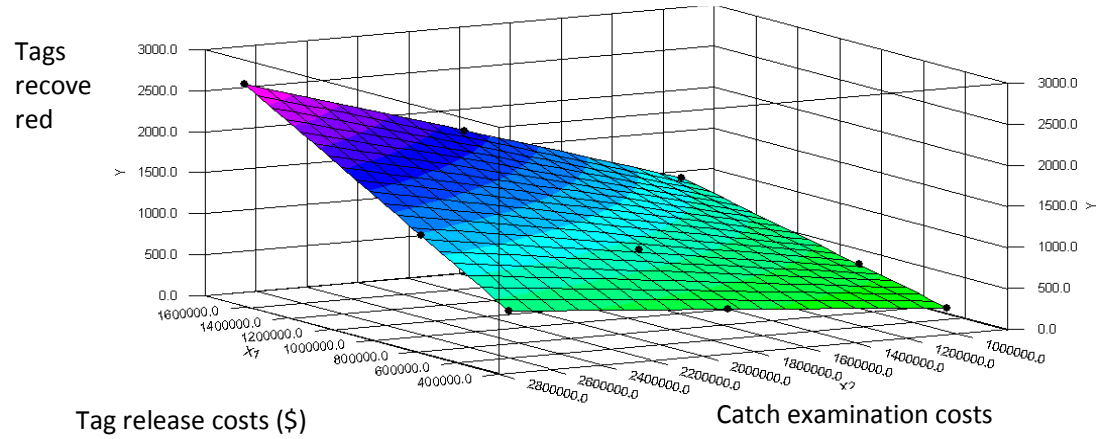


Figure 21: Shape of the predicted tag recovery functional relationship with release and recovery costs.

The optimum cost point on the tag recovery surface for a given number of recoveries tended to favour higher numbers of tags released over a greater proportion of the catch examined (Table 12).

Table 12: Optimum cost of SNA 1 tagging programme designs necessary to achieve a specified number of recoveries.

Target total SNA 1 tag recoveries	Number tags released	% commercial catch examined	Optimum total variable cost	Fixed cost	Total cost
1 000	48 000	40%	$2,630,000	$2,500,000	$5,130,000
1 250	53 800	45%	$2,950,000	$2,500,000	$5,450,000
1 500	59 000	50%	$3,240,000	$2,500,000	$5,740,000
1 750	63 900	55%	$3,500,000	$2,500,000	$6,000,000
2 000	68 600	60%	$3,750,000	$2,500,000	$6,250,000

4 DISCUSSION

A major criticism of past SNA 1 tagging programmes has been their failure to explicitly account for underlying spatial heterogeneity in mark-rates and a failure to account for finer scale spatial movement patterns (Gilbert & McKenzie 1999; Davies et al. 1999). Some insight into likely levels of bias and imprecision resulting from ignoring these two spatially related issues is seen in the simulation results.

The operating reality used in the simulations was based on eight explicit spatial strata with complex underlying movement. Only the eight stratum estimator was capable of exactly matching the movement complexities, yet as it transpired the three stratum estimator performed better than the eight stratum estimator over most design scenarios under homogeneous mixing. The three stratum estimator also attained reasonable fits to the tag movement observations and at estimating movement at the three stratum level. Indications were that the eight stratum design would only start to outperform the three stratum design at very high levels of expected tag recoveries (greater than 3500). The likely reason for the eight stratum design's poorer performance at low tag recovery levels is the large number of estimable parameters this design requires; (136 compared with 41 for the three stratum design). At low to moderate tag recovery levels the ratio of tags to parameters for the eight stratum design is significantly lower than under a three stratum design. Hence, under an eight stratum design, the inherent estimation biases are greater for the same number of tag recoveries. An important conclusion to be drawn from the simulations is that it is better to ignore spatial heterogeneity in the tagging results unless there are a significantly large number of tag recoveries available to represent the very large parameter space needed to account for it.

The GROWTAG estimator did very well at estimating the underlying growth function even at low tag recovery scenarios (approximately 300 tags). There is unlikely to be serious bias or precision issues in estimating the tagged fish growth in future SNA 1 tagging programmes. There will still be an issue of obtaining independent estimates of growth for untagged fish, but this will not be influenced by the choice of tagging programme design (release and recovery strategies). By accurately accounting for growth durinjg the recovery period, the tagging estimator was able to generate relatively precise and unbiased estimates of population numbers numbers for all length class bins with the exception being of the smallest length bin (15–24 cm). The inclusion of a "sacrificial" pre-recruit length bin in future tagging analysis should ensure relatively unbiased population estimates will be obtained for the proportion of the stock above 25 cm.

Biomass was reasonably well estimated for all length bins with the exception of the largest length bin, where the tendency was for biomass to be under-estimated. The root cause of underestimation of the largest length bin was the need to use some proxy (usually data from a commercial method with known selectivity characteristics) of proportional length frequency to scale the estimated population numbers to weight. Because most fishing gears negatively select larger fish the use of a commercial length frequency as a proxy is likely to lead to an under estimate of biomass in the largest length bin. The solution is to over-tag the larger fish to increase recovery numbers and thus enable the inclusion of more length bins in the larger fish range. The extent of bias in the estimation of large fish biomass is directly proportional to the level of discrepancy between the selection curve of the recovery method length frequency proxy and that of the population. In our simulations size-selection bias was introduced as a function of current longline selectivity estimates (Gilbert et al. 1999) which are not significantly domed. As a consequence the level of bias in the largest fish did not overly influence the total population biomass estimates in the simulations. If, in reality, the longline selectivity curve is more domed, then our simulation results are likely to have under-represented the bias.

Trap shyness and the impracticality of tagging fish in deep off-shore areas are known sources of bias not explicitly factored into the simulations. The only way to resolve the off-shore biomass and movement estimates is to provide the estimator with prior information on the relative abundance of the

off-shore population. The cost of the spatial CPUE analysis necessary to provide these ratios was part of the 2.5 million fixed cost estimates for a SNA 1 tagging programme.

There was strong evidence in the 1995 SNA 1 tagging data of a trap-shyness effect for longline and some evidence that the effect may also apply to trawl (Gilbert & McKenzie 1999). We anticipate the need to test for trap-shyness bias in a future SNA 1 tagging programme; and if present the effect will need to be adjusted for in the analysis. It became problematic to introduce a trap-shyness bias effect in the tag design simulation largely because the Working Group could not reach agreement on the level of bias to implement. We believe the magnitude of gear-specific trap-shyness bias in a future SNA 1 tagging programme is likely to be independent of time or spatial location and therefore data from the 1995 SNA 1 tagging could be combined with future tagging programme data to quantify this effect. In our opinion there is no need to modify our design recommendations specifically to accommodate trap-shyness estimation. We believe data obtained from our recommended design for a future SNA 1 tagging programme in combination with the 1995 tagging programme tagging should be sufficient to investigate this source of bias.

Our simulations suggest that under a homogeneous release of tags (or one that is not extremely heterogeneous), relatively precise and accurate estimates of biomass could be obtained for the east Northland, Hauraki Gulf and Bay of Plenty sub-stocks from 1500 to 2000 tag recoveries. Optimisations specific to this range of tag recoveries put the cost of a future SNA 1 tagging programme at between $5,750,000 and $6,250,000 (in 2009 dollars exclusive of GST).

Experience gained in over 25 years of investigation of snapper tagging data means we now have the knowledge and assessment tools to implement a SNA 1 tagging study capable of addressing all significant sources of bias and delivering accurate and precise estimates of sub-stock biomass, population length composition, gear selectivity (relative to nine or ten length bin categories), and estimates of proportional movement between the three main sub-stocks. The results of our simulations suggest that all this is achievable with an investment of $6,250,000. Under the current sector-group allocation split in SNA 1, the commercial fishing industry is responsible for meeting 63% of the research costs; meaning industry would need to provide $3,940,000 for a SNA 1 tagging programme. Apportioned over 2.5 years, this investment represents less than 3% of the port 2009 price value of the commercial fishery. Given that tagging programmes are unlikely to be undertaken on intervals of less than ten to fifteen years the expected return on investment is impressive. On a per-research-dollar investment basis; over a ten year period, no other stock monitoring option for SNA 1 can provide the same level of assessment surety and management utility as that provided by a single SNA 1 tagging programme.

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6 APPENDICES

Appendix 1: Basic (Petersen) tagging estimator for closed populations.

The simplest tagging experiment involves a single tag release followed by a second sampling event to recover tagged animals. The second event provides an estimate of the initial population tag-ratio. From this a population estimate can be derived using the Petersen estimator:

$$\hat{N}_{t1} = \frac{n_{1t1} n_{2t2}}{m_{2t2}}$$

Where: $\hat{N}_{t1}$ = estimated number of animals in population at time *t1*
n_{1t1} = number of marked animals in population *N* at time *t1*
n_{2t2} = number of animals examined for marks in population *N* at time *t2*
m_{2t2} = number of marked animals recovered from population *N* at time *t2*

The Petersen estimator has two implicit assumptions: that the population is closed over the time interval *t1* to *t2* and that tagged animals are homogenously mixed in the population at time *t2*. The closure assumption only needs to hold for additive processes i.e. immigration and recruitment. In general the initial tag ratio ($\frac{n_{1t2}}{N_{t2}}$) is unchanged by removal processes (emigration, mortality) occurring over the interval *t2-t1;* if these processes act equally on tagged and untagged animals then.

$$\frac{n_{1t1}}{N_{t1}} = \frac{n_{1t2}}{N_{t2}} = \frac{m_{2t2}}{n_{2t2}}$$

It is important to realise that the population mark-rate represents $\left(\frac{n_{1t2}}{N_{t2}}\right)$ the expectation or probability of observing a tag in the recovery sample $\left(n_{2t2}\right)$ at *t2*. Because tag recoveries are only observed as integers, the mark rate estimate $\left(\frac{m_{2t2}}{n_{2t2}}\right)$ and therefore $\hat{N}_{t1}$ will be biased at low sample sizes. Bias corrections and tagging estimator likelihood functions are described by a number of authors (Chapman 1951; Robson & Regier 1964; Gaskell & George 1972); see Seber (1982) for an overview.In general, recovery sample (m_{2t2}) sizes of less than 4 at the stratified design level should be avoided, recovery sample sizes greater than 10 have a better than 95% probability of producing unbiased estimates (Seber 1982).

Appendix 2: Probability of initial tag release mortality.

Estimates of tag-release mortality were derived using two logistic regression predictors (logits); one each for trawl and longline capture-release methods. Logit parameter values were derived as maximum likelihood fits to the combined data from three mortality experiments (Gilbert & McKenzie 1999).

The fitted logit function for trawl released fish was:

$$logit_{trawl} = 1.6979 + 0.00126C - 0.0842L$$

Where C is the total catch weight (kg) of the trawl capture shot and L is the length of the fish in centimetres.

The logit function for longline released fish was:

$$logit_{longline} = -4.6423 + 0.0548D$$

where D is the depth (m) at which the fish was captured for tagging.

The release mortality probability p[M] of a tagged snapper from an individual shot or set is:

$$p[M] = \frac{logit}{(1 + logit)}$$

Appendix 3: Operating model exponential growth functions.

Process	Formulae	Description
Tagged fish expected growth increment (instantaneous exponential function)	$\frac{1}{\lambda}\ln\left[1+\lambda\kappa\Delta t\exp(-\lambda l)\right]$ where $\lambda = \frac{1}{\beta-\alpha}\ln\left[\frac{\mu_\alpha}{\mu_\beta}\right]$ $\kappa = \mu_\alpha\left(\frac{\mu_\alpha}{\mu_\beta}\right)^{\frac{\alpha}{\beta-\alpha}}$ $\Delta t = t_2 - t_1 + \frac{\theta}{2\pi}\{\sin[2\pi(t_2-\omega)] - \sin[2\pi(t_1-\omega)]\}$	For fish of length l (cm) from time t_1 to t_2 (y)
Growth increment density function (lognormal)	$\frac{1}{\sqrt{2\pi v}\Delta l}\exp\left[-\frac{1}{2v}\left\{\log\left(\frac{\Delta l}{\mu}\right)+\frac{1}{2}v\right\}^2\right]$ where $v = \sigma^2\mu$	The distribution of growth increment Δl (cm) around its expected value μ (cm)

The Growth transition matrix projects each length class in the population forward in time in the form of a distribution (Figure i). The final projected population distribution is produced by summing all the individual length class projections (Figure ii).

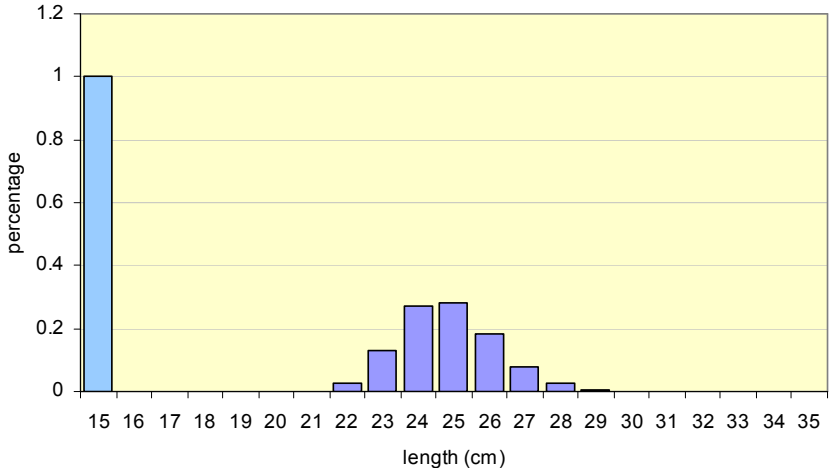


Figure i: **Distribution of the 15 cm length class (light) after 18 months growth with σ = 0.4263 (dark).**

		projected length Time 2									
		17	18	19	20	21	22	23	24	25	26
original length	15	0.182227	0.491477	0.255227	0.059306	0.011764	0	0	0	0	0
	16		0.199641	0.495516	0.241264	0.053185	0.010394	0	0	0	0
	17			0.218212	0.497942	0	growth transition matrix		0	0	0
	18				0.237932	0.498672	0.212952	0.042173	0.008271	0	0
	19					0.25878	0.497638	0.198786	0.037278	0.007518	0
	20						0.280717	0.494786	0.184733	0.032782	0.006982

		17	18	19	20	21	22	23	24	25	26
1000	15	182	491	255	59	12	0	0	0	0	0
2000	16	0	399	991	483	106	21	0	0	0	0
5000	17	0	0	1091	2490	1136	237	46	0	0	0
6000	18	0	0	0	1428	2992	1278	253	50	0	0
3000	19	0	0	0	0	776	1493	596	112	23	0
2000	20	0	0	0	0	0	561	990	369	66	14
		182	890	2337	4460	5022	3590	1885	531	89	14

	original	projected
14	0	0
15	1000	0
16	2000	0
17	5000	182
18	6000	890
19	3000	2337
20	2000	4460
21	0	5022
22	0	3590
23	0	1885
24	0	531
25	0	89
26	0	14

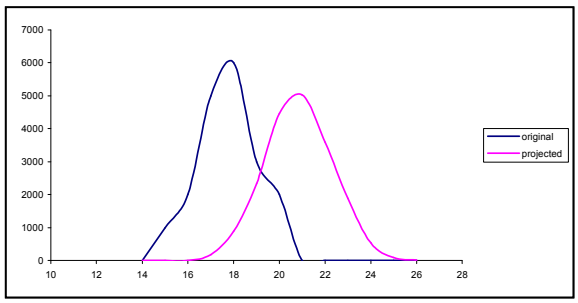


Figure ii. **Growth matrix length frequency projection matrix example.**

Variation on the growth trajectories of individual tagged fish was achieved using the random deviates $\mu_\alpha'\mu_\beta'$ instead of μ_α and μ_β The distributions for $\mu_\alpha'\mu_\beta'$ being:

$$\mu'_\alpha \sim LogN(\mu_\alpha, \sigma^2)$$
$$\mu'_\beta \sim LogN(\mu_\beta, \sigma^2)$$

where μ_α =2.89, μ_β =5.47, and σ^2 =0.4263

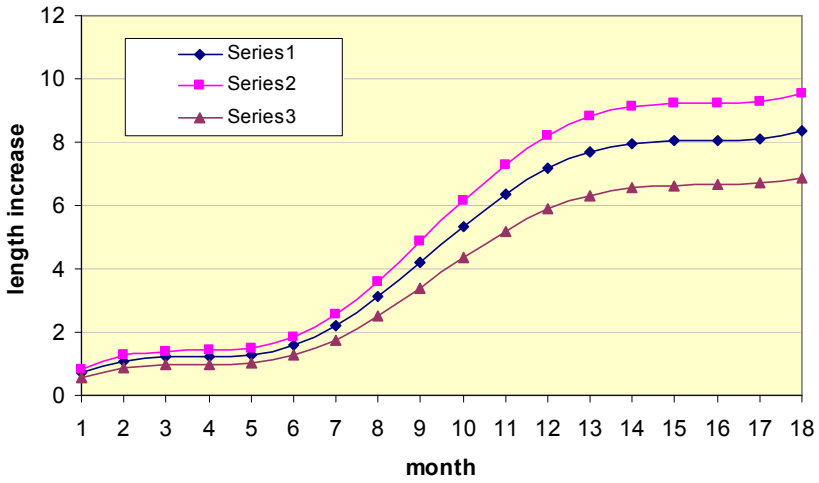


Figure iii: **Growth trajectories of three randomly drawn 15 cm tagged fish during an 18 month recovery period**

Appendix 4: Total catch (kg) of snapper by method area and month used by the operating model to establish catch examination limits. Catch limits are based on average SNA 1 catch data from five recent fishing years.

model recovery months

longline

stratum	6month	7month	8month	9month	10month	11month	12month	13month	14month	15month	16month	17month	18month
ENLD1	28813	25979	26247	23565	17070	19785	37304	30846	19382	23474	20508	12533	28813
ENLD2	28813	25979	26247	23565	17070	19785	37304	30846	19382	23474	20508	12533	28813
HAGU1	25256	32344	30129	29045	20362	18160	16606	11169	6065	9214	9807	12526	25256
HAGU2	25256	32344	30129	29045	20362	18160	16606	11169	6065	9214	9807	12526	25256
HAGU3	25256	32344	30129	29045	20362	18160	16606	11169	6065	9214	9807	12526	25256
BPLE1	10816	6342	9034	8964	9142	7290	9056	9684	6827	6266	8225	8595	10816
BPLE2	10816	6342	9034	8964	9142	7290	9056	9684	6827	6266	8225	8595	10816
BPLE3	10816	6342	9034	8964	9142	7290	9056	9684	6827	6266	8225	8595	10816

single trawl

stratum	6month	7month	8month	9month	10month	11month	12month	13month	14month	15month	16month	17month	18month
ENLD1	19866	28941	25214	18543	18014	15163	16332	20578	19904	17409	25882	28812	19866
ENLD2	19866	28941	25214	18543	18014	15163	16332	20578	19904	17409	25882	28812	19866
HAGU1	31295	42067	33570	19467	10953	10963	12522	4212	12965	15736	26881	24376	31295
HAGU2	31295	42067	33570	19467	10953	10963	12522	4212	12965	15736	26881	24376	31295
HAGU3	31295	42067	33570	19467	10953	10963	12522	4212	12965	15736	26881	24376	31295
BPLE1	16445	11952	18946	13147	10105	19373	19550	24658	13206	11654	17472	26794	16445
BPLE2	16445	11952	18946	13147	10105	19373	19550	24658	13206	11654	17472	26794	16445
BPLE3	16445	11952	18946	13147	10105	19373	19550	24658	13206	11654	17472	26794	16445

Danish seine

stratum	6month	7month	8month	9month	10month	11month	12month	13month	14month	15month	16month	17month	18month
ENLD1	5830	6246	6993	3518	4263	2392	4749	3009	3860	8794	8203	3205	5830
ENLD2	5830	6246	6993	3518	4263	2392	4749	3009	3860	8794	8203	3205	5830
HAGU1	10488	3698	9292	13900	26756	10840	11178	5951	3352	2603	7782	17348	10488
HAGU2	10488	3698	9292	13900	26756	10840	11178	5951	3352	2603	7782	17348	10488
HAGU3	10488	3698	9292	13900	26756	10840	11178	5951	3352	2603	7782	17348	10488
BPLE1	8874	5814	16833	8350	11519	7359	596	1312	2206	18680	14409	15479	8874
BPLE2	8874	5814	16833	8350	11519	7359	596	1312	2206	18680	14409	15479	8874
BPLE3	8874	5814	16833	8350	11519	7359	596	1312	2206	18680	14409	15479	8874

Appendix 5: Equilibrium properties of Markovian proportional movement matrices.

The proportion of a fish moving from stratum *i* to stratum *j* in a unit time interval is denoted by $\theta_{i\to j}$. The matrix of all possible movements can be written as

$$\begin{matrix} \theta_{1\to 1} & \theta_{2\to 1} & \cdots & \theta_{i\to 1} \\ \theta_{1\to 2} & \theta_{2\to 2} & \cdots & \theta_{i\to 2} \\ \vdots & \vdots & & \vdots \\ \theta_{1\to j} & \theta_{2\to j} & \cdots & \theta_{i\to j} \end{matrix}$$

The matrix $\{\theta_{i\to j}\}$ is denoted as Θ (after Quinn & Deriso 1999). Because Θ is a matrix of proportions its column elements must sum to 1, it therefore has n^2-n degrees of freedom where n is the total number of strata in the population.

The population **N** can be represented as a vector of stratum populations $\begin{pmatrix} N_1 \\ \vdots \\ N_n \end{pmatrix}$.

Assuming that **N** is closed the spatial distribution of **N** at integer time step t_1 is given by $\Theta\,\mathbf{N}_{t0}$. Application of Θ over a number of time steps will always result in a stable spatial distribution (**E** the equilibrium distribution of **N)** regardless of its initial distribution (i.e. $\mathbf{E} = \Theta^{\infty}\,\mathbf{N}_{t0}$**)**. This implies that the equilibrium distributions of tags released in each strata (N_i) will all be the same, i.e. the equilibrium solution for $\{\Theta N_1, \Theta N_2 \cdots \Theta N_i\}$ is a single vector with only n-1 free parameters such that $E_1 = E_2 = \ldots E_i$

It is possible to calculate the equilibrium population distribution **E** of **N** for any movement matrix Θ; the algebra, which involves solving a set of simultaneous equations, is as follows:

Let **I** be the identity matrix of **E** and **0** be a vector of zeros of equivalent length to **E**.

Then:

$\mathbf{E} = \Theta\,\mathbf{E}$

=>

$\mathbf{IE} = \Theta\,\mathbf{E}$

=>

$(\mathbf{I} - \Theta)\mathbf{E} = \mathbf{0}$

$\therefore$

$$\left[\begin{pmatrix} 1 & 0 & \ldots & 0 \\ 0 & 1 & \ldots & 0 \\ \vdots & \vdots & & \vdots \\ 0 & 0 & \ldots & 1 \end{pmatrix} - \begin{pmatrix} \theta_{1\to1} & \theta_{2\to1} & \ldots & \theta_{i\to1} \\ \theta_{1\to2} & \theta_{2\to2} & \ldots & \theta_{i\to2} \\ \vdots & \vdots & & \vdots \\ \theta_{1\to j} & \theta_{2\to j} & \ldots & \theta_{i\to j} \end{pmatrix}\right]\begin{pmatrix} E_1 \\ E_2 \\ \vdots \\ E_j \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ \vdots \\ 0 \end{pmatrix}$$

which gives rise to the following set of simultaneous equations:

$$\begin{array}{ccccccccc} (1-\theta_{1\to1})E_1 & + & (-\theta_{2\to1})E_2 & + & \cdots & + & (-\theta_{i\to1})E_j = & 0 \\ (-\theta_{1\to2})E_1 & + & (1-\theta_{2\to2})E_2 & + & \cdots & + & (-\theta_{i\to2})E_j = & 0 \\ \vdots & & \vdots & & \vdots & & \vdots & \vdots \\ (-\theta_{1\to j})E_1 & + & (-\theta_{2\to j})E_2 & + & \cdots & + & (1-\theta_{i\to j})E_j = & 0 \end{array}$$

Although there are *j* elements in E and *j* equations all the above equations have zero solutions, i.e. the Gaussian solution matrix will be singular. A non-zero equation is needed in place of any one of the above equations. Given that the columns in Θ each sum to one, the sum of the series of equations produced by Θ E gives

$$1E_1 + 1E_2 + \cdots + 1E_j = \sum E_j$$

a non-zero expression of **E**.

Example 1: The equilibrium solution for1000 tags released into a three-stratum population **N** with

$$\Theta = \begin{pmatrix} 0.7 & 0.1 & 0.1 \\ 0.2 & 0.8 & 0.1 \\ 0.1 & 0.1 & 0.8 \end{pmatrix} \text{ gives } \mathbf{E} = \begin{pmatrix} 250.00 \\ 416.66 \\ 333.33 \end{pmatrix} \text{ (Figure i).}$$

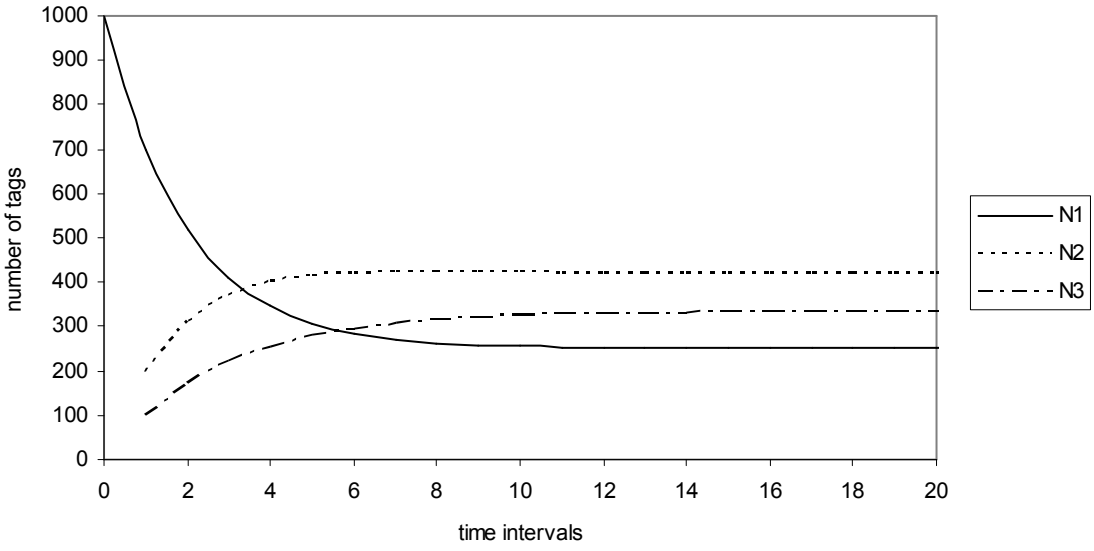


Figure i: Predicted proportions of 1000 tags released in stratum N_1; equilibrium is achieved after approximately 14 time steps.

Example 2: If the outward and inward movement proportional net change is equal for all elements of Θ (i.e. $\theta_{i\to j} = \theta_{j\to i}$ for all j i so that Θ is symmetric about the main diagonal) all **E** strata will contain equal numbers of tagged fish. Example: the equilibrium solution for 1000 tags released into a three-stratum population **N** with $\Theta = \begin{pmatrix} 0.7 & 0.2 & 0.1 \\ 0.2 & 0.8 & 0.1 \\ 0.1 & 0.1 & 0.8 \end{pmatrix}$ gives $\mathbf{E} = \begin{pmatrix} 333.33 \\ 333.33 \\ 333.33 \end{pmatrix}$ (Figure ii).

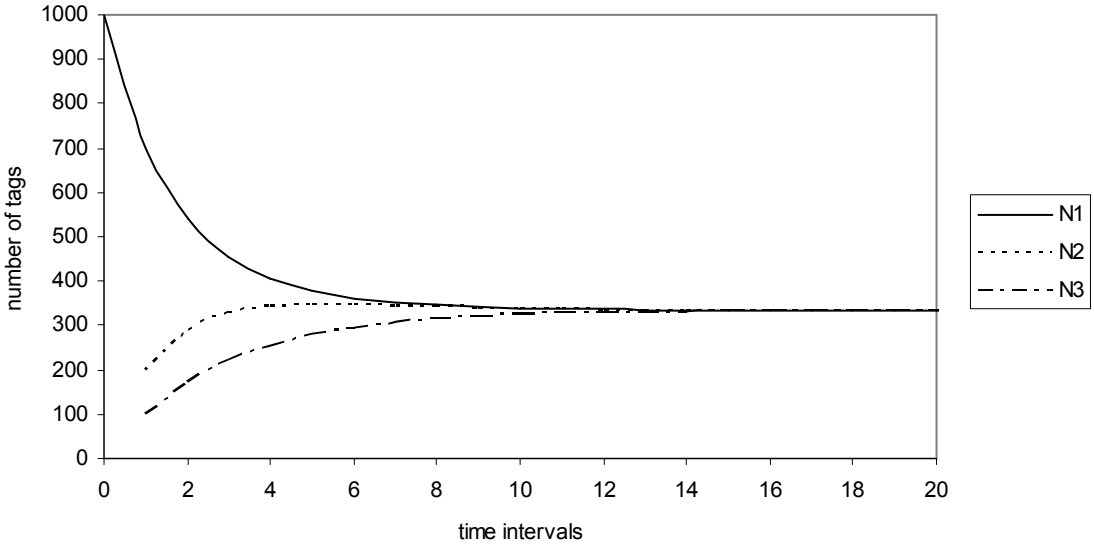


Figure ii: **Predicted proportions of 1000 tags released in stratum N_1 where Θ is symmetric: equilibrium is achieved after approximately 14 time steps.**

Appendix 6: The derivation of the vector of "actual" numbers of fish in each stratum (A) under HF movement.

The matrix of instantaneous probabilities of observing a H_x fish in stratum j $\{\varphi_{x\to j}\}$[2] or $\boldsymbol{\psi}$ is given by:

$$\Psi = \begin{pmatrix} \varphi_{1\to 1} & \cdots & \varphi_{x\to 1} \\ \vdots & \ddots & \vdots \\ \varphi_{1\to x} & \cdots & \varphi_{x\to x} \end{pmatrix}$$

The vector **(A) of** "actual" number of fish in each stratum (A_x) is given by:

$$\boldsymbol{\psi}\,\mathbf{H} = \mathbf{A}$$

The solution for **H** given **A** and $\boldsymbol{\psi}$ can be derived by Gaussian elimination as a series of simultaneous equations:

$$\begin{matrix} \varphi_{1\to 1}H_1 + & \cdots & + \varphi_{x\to 1}H_x = A_1 \\ \vdots & \ddots & \vdots \\ \varphi_{1\to x}H_1 + & \cdots & + \varphi_{x\to x}H_x = A_x \end{matrix}$$

[2] Individual probabilities also denoted as P[*xj*] in the main report

Appendix 7: Derivation of the home population instantaneous movement probability matrix ψ.

The instantaneous movement probability matrix ψ defines the spatial probability distribution of all the home stratum populations H_x. This matrix was derived on the basis of a single parameter σ which defined the probability of movement to a stratum immediately adjacent to the home stratum. The probability of fish being in successively more distant strata decreased as a power function of σ (Table i).

A heterogeneous (complex) movement matrix was generated for the operating model by setting σ at different values for east Northland, Hauraki Gulf, and Bay of Plenty (0.18; 0.15; 0.12 Table ii)

Table i: Instantaneous movement probability matrix ψ as a function of σ

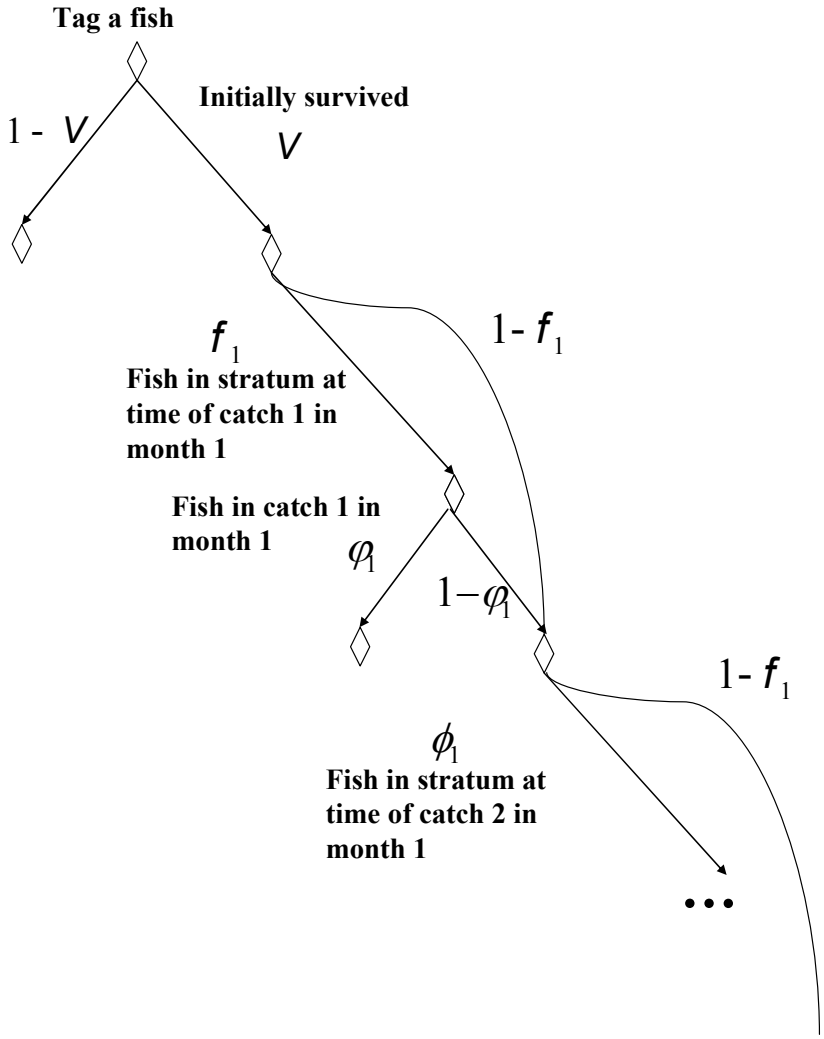
Release	Recovery	east Northland 1	east Northland 2	Hauraki Gulf 3	Hauraki Gulf 4	Hauraki Gulf 5	Bay of Plenty 6	Bay of Plenty 7	Bay of Plenty 8
east Northland	1	$1-(\sigma+ \dots \sigma^7)$	σ	σ^2	σ^3	σ^4	σ^5	σ^6	σ^7
	2	σ	$1-(\sigma+ \dots \sigma^6)$	σ	σ^2	σ^3	σ^4	σ^5	σ^6
Hauraki Gulf	3	σ^2	σ	$1-(\sigma+ \dots \sigma^5)$	σ	σ^2	σ^3	σ^4	σ^5
	4	σ^3	σ^2	σ	$1-(\sigma+ \dots \sigma^4)$	σ	σ^2	σ^3	σ^4
	5	σ^4	σ^3	σ^2	σ	$1-(\sigma+ \dots \sigma^4)$	σ	σ^2	σ^3
Bay of Plenty	6	σ^5	σ^4	σ^3	σ^2	σ	$1-(\sigma+ \dots \sigma^5)$	σ	σ^2
	7	σ^6	σ^5	σ^4	σ^3	σ^2	σ	$1-(\sigma+ \dots \sigma^6)$	σ
	8	σ^7	σ^6	σ^5	σ^4	σ^3	σ^2	σ	$1-(\sigma+ \dots \sigma^7)$

Table ii: Operating model instantaneous movement probability matrix parameters

	east Northland 1	*east Northland* 2	*Hauraki Gulf* 3	*Hauraki Gulf* 4	*Hauraki Gulf* 5	*Bay of Plenty* 6	*Bay of Plenty* 7	*Bay of Plenty* 8
east Northland	σ = 0.18							
1	0.78048915	0.18	0.0324	0.005832	0.00104976	0.00018896	3.4012E-05	6.1222E-06
2	0.18	0.60049527	0.18	0.0324	0.005832	0.00104976	0.00018896	3.4012E-05
Hauraki Gulf	σ = 0.15							
3	0.0225	0.15	0.65104281	0.15	0.0225	0.003375	0.00050625	7.5938E-05
4	0.003375	0.0225	0.15	0.64774375	0.15	0.0225	0.003375	0.00050625
5	0.00050625	0.003375	0.0225	0.15	0.64774375	0.15	0.0225	0.003375
Bay of Plenty	σ = 0.12							
6	2.4883E-05	0.00020736	0.001728	0.0144	0.12	0.72923976	0.12	0.0144
7	2.986E-06	2.4883E-05	0.00020736	0.001728	0.0144	0.12	0.74363677	0.12
8	3.5832E-07	2.986E-06	2.4883E-05	0.00020736	0.001728	0.0144	0.12	0.86363641

Appendix 8: Recapture probability decision tree sequence.

The sequential probability process to determine tagged recapture-fates; each tagged fish is searched for in every catch in every month. This inspection process only stops when the fish is caught or when the last catch is examined:



Appendix 9: Root mean square error (RMSE) and bias calculation.

Scenarios were compared on the basis of root mean square error (RMSE) on the population biomass and other parameters of interest given by:

$$RMSE_{F_m(x)} = \sqrt{\frac{1}{N}\sum_{i=0}^{N}[\hat{F}_m(x_i) - F_m(x_i)]^2}$$

Where:

N	=	number of bootstraps
m	=	scenario
$F_m(x)$	=	a function of parameter x
$\hat{F}_m(x_i)$	=	estimator value for the function $F_m(x)$ from the ith bootstrap
$F_m(x_i)$	=	operating model (true) value for the function $F_m(x)$ from the ith bootstrap

The coefficient of variation (c.v.) is $RMSE_m$ as a proportion of the bootstrap mean:

$$cv = \frac{RMSE_m}{E[F_m(x)]}$$

The RMSE of the summation of, for example, the individual stratum biomass estimates B_n is given by:

$$RMSE_{\sum B_n} = \sqrt{\sum_{i=1}^{n} RMSE_{B_i}{}^2}$$

$$cv = \frac{RMSE_{\sum B_n}}{\sum B_n}$$

Bias was expressed as a proportion of the expected value of the parameter or statistic of interest to the (operating model) value:

$$Bias_{\hat{F}_m(x)} = \frac{\hat{F}_m(x)}{F_m(x)}$$

Appendix 10: Base-case (homogeneous tag release) simulation analysis summary tables for three spatial strata programme design.

a. Design scenario: 30% examination of commercial catch; 15000 tags released

```
Mean number of tags released
  stratum     Tags     Cost
1       1 4280.537 64167.34
2       2 7340.993 95474.98
3       3 4790.539 73239.60
      tot     Tags     Cost
1 Total   16412.07 232881.9

Mean number of fish examined
  stratum Fishexam     Cost
1       1 493946.3 422794.0
2       2 778728.0 282959.5
3       3 570076.5 277867.5
       tot    exam   Cost
1 Total    1842751 983621

Mean number of tags recovered
  stratum      Tags
1       1  67.03275
2       2 117.35926
3       3  83.32753
       tot     tags
1 Total    267.7195

=====================================================================
POPULATION FITS
=====================================================================

BY STRATUM & LENGTH

Total fits by length bin
```

numbers

	stock	stratum	length_bin	true_pop	exp_pop	RMSE	CV	LR2.5	UP97.5	bias
1	1	1	1	16967870	19292367	70913023	4.1792531	146526.64	69532704	1.1369940
2	1	1	2	3301269	3719869	3084362	0.9342958	90641.56	11386667	1.1267997
3	1	1	3	4652575	5077918	3202764	0.6883852	1779487.76	13079781	1.0914209
4	1	1	4	1381480	2527821	6589600	4.7699571	53751.03	9406187	1.8297919
5	1	1	5	2280736	3179634	3601508	1.5790991	293244.71	11966706	1.3941263
6	1	1	6	1690434	2886981	4532647	2.6813511	196426.41	12209897	1.7078340
7	1	1	7	2695764	3678276	3164984	1.1740581	1080132.43	10032514	1.3644651
8	1	1	8	1294287	2290535	7788864	6.0178804	44541.61	8249724	1.7697276
9	1	1	9	1435985	1695112	2464114	1.7159752	45599.33	5693934	1.1804531
10	2	2	1	29809355	18307895	21028538	0.7054342	1027922.48	52965499	0.6141661
11	2	2	2	5898813	6612015	3700202	0.6272790	289008.51	15619218	1.1209061
12	2	2	3	7762039	8359287	3289811	0.4238334	885535.38	16712800	1.0769447
13	2	2	4	2251332	2603183	1985978	0.8821345	133223.53	6640165	1.1562855
14	2	2	5	3837585	4276597	2133699	0.5560005	341565.75	9597513	1.1143979
15	2	2	6	3051663	3533155	2428712	0.7958652	206793.79	9052832	1.1577802
16	2	2	7	4201882	4630075	2244008	0.5340483	366084.02	10291896	1.1019051
17	2	2	8	2048807	2389350	1722361	0.8406658	135358.29	6246165	1.1662153
18	2	2	9	2229915	2355033	1895913	0.8502175	128196.66	7459297	1.0561086
19	3	3	1	18749189	23352056	59972018	3.1986460	289343.57	140541393	1.2454969
20	3	3	2	3765785	4175965	2510622	0.6666929	444165.56	10165163	1.1089229
21	3	3	3	5044362	5127591	2087245	0.4137779	2435052.98	9959469	1.0164994
22	3	3	4	1396332	1996306	3024467	2.1660084	58102.30	8076425	1.4296784
23	3	3	5	2269169	2645681	1933040	0.8518715	382627.66	7187176	1.1659252
24	3	3	6	1616635	2073636	1977669	1.2233246	103062.51	6827380	1.2826864
25	3	3	7	2374611	2817485	1869113	0.7871238	361792.35	7576202	1.1865038
26	3	3	8	1290950	2314360	6377911	4.9404775	56080.56	9790507	1.7927565
27	3	3	9	1943119	2822724	5076896	2.6127552	68570.17	12381355	1.4526763

biomass

	stock	stratum	length_bin	true_bio	exp_bio	RMSE_bio	CV_bio	LR2.5	UP97.5	bias
2	1	1	2	1250.8526	1411.436	1170.4878	0.9357520	34.4	4320.1	1.1283795
3	1	1	3	2292.1822	2487.308	1567.2695	0.6837456	871.6	6411.3	1.0851266
4	1	1	4	824.0626	1507.861	3930.7426	4.7699562	32.1	5610.9	1.8297888
5	1	1	5	1555.6796	2167.903	2455.1055	1.5781562	200.0	8160.0	1.3935407
6	1	1	6	1367.3543	2338.309	3671.5470	2.6851468	159.1	9882.3	1.7100972
7	1	1	7	2839.7450	3879.496	3339.5181	1.1759923	1138.0	10578.4	1.3661423
8	1	1	8	1964.1889	3459.259	11772.4179	5.9935263	67.3	12444.9	1.7611641

9	1	1	9	4313.6008	4469.775	6463.4584	1.4983905	120.3	15200.2	1.0362051
11	2	2	2	2236.2343	2510.690	1405.7075	0.6286047	109.8	5930.7	1.1227313
12	2	2	3	3812.8285	4098.752	1611.7014	0.4227049	434.3	8190.7	1.0749897
13	2	2	4	1342.9355	1552.817	1184.6503	0.8821349	79.5	3960.9	1.1562854
14	2	2	5	2620.1145	2915.882	1454.0636	0.5549619	232.9	6543.8	1.1128834
15	2	2	6	2471.0890	2860.582	1966.3201	0.7957302	167.4	7330.1	1.1576200
16	2	2	7	4395.4781	4854.169	2354.2496	0.5356072	384.1	10807.3	1.1043552
17	2	2	8	3086.9274	3614.295	2607.5003	0.8446911	204.8	9441.3	1.1708391
18	2	2	9	7115.6112	6282.023	5112.5393	0.7184962	336.7	19967.5	0.8828508
20	3	3	2	1426.8460	1583.921	952.5638	0.6676010	168.4	3854.8	1.1100853
21	3	3	3	2477.8967	2510.650	1021.8372	0.4123809	1193.0	4871.6	1.0132180
22	3	3	4	832.9220	1190.811	1804.1158	2.1660082	34.7	4817.6	1.4296785
23	3	3	5	1547.2618	1803.216	1317.4292	0.8514585	260.8	4897.6	1.1654239
24	3	3	6	1307.5613	1678.944	1601.4581	1.2247671	83.4	5527.1	1.2840269
25	3	3	7	2496.4956	2956.479	1960.3918	0.7852574	379.6	7944.3	1.1842517
26	3	3	8	1957.3738	3488.902	9614.2492	4.9118104	84.6	14770.4	1.7824405
27	3	3	9	6542.3856	7642.300	13639.9608	2.0848604	185.8	33720.7	1.1681213

BY STOCK & LENGTH

Total fits by length bin

numbers

	stock	length_bin	true_pop	exp_pop	RMSE	CV	bias
1	1	1	16967870	19292367	70913023	4.1792531	1.1369940
4	1	2	3301269	3719869	3084362	0.9342958	1.1267997
7	1	3	4652575	5077918	3202764	0.6883852	1.0914209
10	1	4	1381480	2527821	6589600	4.7699571	1.8297919
13	1	5	2280736	3179634	3601508	1.5790991	1.3941263
16	1	6	1690434	2886981	4532647	2.6813511	1.7078340
19	1	7	2695764	3678276	3164984	1.1740581	1.3644651
22	1	8	1294287	2290535	7788864	6.0178804	1.7697276
25	1	9	1435985	1695112	2464114	1.7159752	1.1804531
2	2	1	29809355	18307895	21028538	0.7054342	0.6141661
5	2	2	5898813	6612015	3700202	0.6272790	1.1209061
8	2	3	7762039	8359287	3289811	0.4238334	1.0769447
11	2	4	2251332	2603183	1985978	0.8821345	1.1562855
14	2	5	3837585	4276597	2133699	0.5560005	1.1143979
17	2	6	3051663	3533155	2428712	0.7958652	1.1577802
20	2	7	4201882	4630075	2244008	0.5340483	1.1019051
23	2	8	2048807	2389350	1722361	0.8406658	1.1662153
26	2	9	2229915	2355033	1895913	0.8502175	1.0561086
3	3	1	18749189	23352056	59972018	3.1986460	1.2454969
6	3	2	3765785	4175965	2510622	0.6666929	1.1089229
9	3	3	5044362	5127591	2087245	0.4137779	1.0164994
12	3	4	1396332	1996306	3024467	2.1660084	1.4296784
15	3	5	2269169	2645681	1933040	0.8518715	1.1659252
18	3	6	1616635	2073636	1977669	1.2233246	1.2826864
21	3	7	2374611	2817485	1869113	0.7871238	1.1865038
24	3	8	1290950	2314360	6377911	4.9404775	1.7927565
27	3	9	1943119	2822724	5076896	2.6127552	1.4526763

biomass

	stock	length_bin	true_bio	exp_bio	RMSE	CV	bias
1	1	2	1250.8526	1411.436	1170.4878	0.9357520	1.1283795
4	1	3	2292.1822	2487.308	1567.2695	0.6837456	1.0851266
7	1	4	824.0626	1507.861	3930.7426	4.7699562	1.8297888
10	1	5	1555.6796	2167.903	2455.1055	1.5781562	1.3935407
13	1	6	1367.3543	2338.309	3671.5470	2.6851468	1.7100972
16	1	7	2839.7450	3879.496	3339.5181	1.1759923	1.3661423
19	1	8	1964.1889	3459.259	11772.4179	5.9935263	1.7611641
22	1	9	4313.6008	4469.775	6463.4584	1.4983905	1.0362051
2	2	2	2236.2343	2510.690	1405.7075	0.6286047	1.1227313
5	2	3	3812.8285	4098.752	1611.7014	0.4227049	1.0749897
8	2	4	1342.9355	1552.817	1184.6503	0.8821349	1.1562854
11	2	5	2620.1145	2915.882	1454.0636	0.5549619	1.1128834
14	2	6	2471.0890	2860.582	1966.3201	0.7957302	1.1576200
17	2	7	4395.4781	4854.169	2354.2496	0.5356072	1.1043552
20	2	8	3086.9274	3614.295	2607.5003	0.8446911	1.1708391
23	2	9	7115.6112	6282.023	5112.5393	0.7184962	0.8828508
3	3	2	1426.8460	1583.921	952.5638	0.6676010	1.1100853
6	3	3	2477.8967	2510.650	1021.8372	0.4123809	1.0132180
9	3	4	832.9220	1190.811	1804.1158	2.1660082	1.4296785
12	3	5	1547.2618	1803.216	1317.4292	0.8514585	1.1654239
15	3	6	1307.5613	1678.944	1601.4581	1.2247671	1.2840269

```
18     3          7 2496.4956 2956.479  1960.3918 0.7852574 1.1842517
21     3          8 1957.3738 3488.902  9614.2492 4.9118104 1.7824405
24     3          9 6542.3856 7642.300 13639.9608 2.0848604 1.1681213
```

```
STRATUM FITS +25cm
   numbers
  stratum true_pop  exp_pop     RMSE        CV     bias
1       1 18732530 25056146 13170610 0.7030876 1.337574
2       2 31282036 34758694  7106782 0.2271841 1.111139
3       3 19700964 23973748  9869207 0.5009505 1.216882

   biomass
  stratum true_bio  exp_bio      RMSE        CV     bias
1       1 16407.67 21721.35 15175.751 0.9249183 1.323854
2       2 27081.22 28689.21  7101.923 0.2622453 1.059377
3       3 18588.74 22855.22 17083.094 0.9190021 1.229520
```

```
STOCK FITS +25cm
   numbers
  stock true_pop  exp_pop     RMSE        CV     bias
1     1 18732530 25056146 13170610 0.7030876 1.337574
2     2 31282036 34758694  7106782 0.2271841 1.111139
3     3 19700964 23973748  9869207 0.5009505 1.216882

   biomass
  stock true_bio  exp_bio      RMSE        CV     bias
1     1 16407.67 21721.35 15175.751 0.9249183 1.323854
2     2 27081.22 28689.21  7101.923 0.2622453 1.059377
3     3 18588.74 22855.22 17083.094 0.9190021 1.229520
```

```
SNA 1 FITS (25 cm +)
   numbers
  true_pop  exp_pop     RMSE        CV     bias
1 69715530 83788587 17926867 0.2571431 1.201864

   biomass
  true_bio  exp_bio     RMSE        CV     bias
1 62077.63 73265.78 23928.49 0.3854608 1.180228
```

```
======================================================================
TAG RECOVERY FITS
======================================================================
  release recovery      TagObs     TagExp     RMSE          CV
1       1        1 56.30092119 55.1214765 2.976737  0.05287191
2       1        2 15.03377687 12.6897817 3.722781  0.24762777
3       1        3  0.08700102  0.8301511 1.170222 13.45066362
4       2        1 10.58034800 14.0244567 4.516694  0.42689468
5       2        2 89.82906858 88.4237749 3.355674  0.03735621
6       2        3 13.65916070 14.2819645 3.010898  0.22043068
7       3        1  0.15148414  0.8142629 1.115256  7.36219715
8       3        2 12.49641760 12.9827287 3.127327  0.25025792
9       3        3 69.58137155 68.4896554 2.682708  0.03855497


   rec_stra Length_bin    TagObs    TagExp      RMSE         CV
1         1          1  3.256909  3.509516 0.9360370 0.28740043
2         1          2 10.527124 10.869317 1.5489987 0.14714358
3         1          3 17.711361 18.175511 2.0247382 0.11431861
4         1          4  4.364381  4.654714 0.9954116 0.22807625
5         1          5  7.308086  7.686540 1.3029146 0.17828397
6         1          6  4.799386  5.032569 1.0247514 0.21351720
```

7	1	7	7.512794	7.862250	1.2307841	0.16382508
8	1	8	4.643808	4.953270	0.9913613	0.21348027
9	1	9	6.908905	7.216509	0.9407488	0.13616467
10	2	1	6.452405	6.024203	1.2307340	0.19074035
11	2	2	15.001024	14.641813	2.0287297	0.13523942
12	2	3	29.039918	28.649907	2.8113760	0.09681074
13	2	4	8.980553	8.605272	1.3536725	0.15073376
14	2	5	14.713408	14.392370	1.6880935	0.11473164
15	2	6	10.379734	10.106483	1.4292920	0.13770025
16	2	7	15.485159	15.163370	1.7395501	0.11233660
17	2	8	8.269191	7.922267	1.3510213	0.16338009
18	2	9	9.037871	8.590602	1.4309716	0.15833060
19	3	1	3.319345	3.489967	0.8873678	0.26733221
20	3	2	12.714432	12.728174	1.4382750	0.11312145
21	3	3	24.073695	23.998488	1.9311642	0.08021885
22	3	4	5.705220	5.776715	0.9999848	0.17527541
23	3	5	10.084954	10.024496	1.2413972	0.12309399
24	3	6	6.816786	6.850545	0.9977507	0.14636673
25	3	7	10.530194	10.500930	1.2603777	0.11969178
26	3	8	5.063460	5.086874	0.9873279	0.19499078
27	3	9	5.019447	5.145581	1.1500393	0.22911672

	TagObs	TagExp	RMSE	CV
1	267.7195	267.6583	7.460729	0.02786771

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PROPORTIONAL MOVEMENT FITS

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	Lb__Fr__To	true_mm	geo_obs	RMSE	CV	LR2.5	UP97.5
1	1 - 1 - 1	0.85874900	0.733030160	0.29606049	0.3447579	1.10673e-02	0.9802960
2	1 - 1 - 2	0.13905100	0.225099435	0.23855446	1.7155897	1.09944e-02	0.9267350
3	1 - 1 - 3	0.00219992	0.041870405	0.16602677	75.4694573	9.43414e-09	0.8161620
4	1 - 2 - 1	0.15032400	0.165633452	0.20769795	1.3816686	2.83664e-03	0.8138250
5	1 - 2 - 2	0.73855600	0.666844648	0.28230933	0.3822450	5.03335e-02	0.9471270
6	1 - 2 - 3	0.11112000	0.167521914	0.21175783	1.9056680	8.63531e-03	0.8032090
7	1 - 3 - 1	0.00132185	0.029028654	0.13304075	100.6473879	8.41266e-09	0.2327570
8	1 - 3 - 2	0.17721900	0.210947586	0.23201759	1.3092140	9.52479e-03	0.9342760
9	1 - 3 - 3	0.82145900	0.760023760	0.26841830	0.3267580	1.42868e-02	0.9891050
10	2 - 1 - 1	0.86366300	0.745099701	0.25126999	0.2909352	2.04569e-02	0.9680800
11	2 - 1 - 2	0.13411700	0.241833024	0.23495029	1.7518308	1.89832e-02	0.9263800
12	2 - 1 - 3	0.00222005	0.013067284	0.06659956	29.9991252	1.12976e-08	0.0555478
13	2 - 2 - 1	0.17112200	0.145495466	0.17700313	1.0343681	8.83766e-03	0.7837220
14	2 - 2 - 2	0.71157300	0.731202393	0.23443523	0.3294605	3.22608e-02	0.9357490
15	2 - 2 - 3	0.11730500	0.123302130	0.13108702	1.1174888	2.02482e-02	0.6026660
16	2 - 3 - 1	0.00128653	0.015173152	0.09121048	70.8965033	9.84720e-09	0.0408126
17	2 - 3 - 2	0.18045600	0.173346667	0.13937688	0.7723594	1.25785e-02	0.7005350
18	2 - 3 - 3	0.81825700	0.811480183	0.16202929	0.1980176	6.33760e-02	0.9813360
19	3 - 1 - 1	0.86416500	0.797688949	0.14612481	0.1690936	3.58879e-01	0.9499810
20	3 - 1 - 2	0.13369200	0.193932979	0.13676679	1.0229991	4.01082e-02	0.5715650
21	3 - 1 - 3	0.00214275	0.008378071	0.04188405	19.5468665	1.12329e-08	0.0299011
22	3 - 2 - 1	0.15860200	0.128906715	0.14027949	0.8844749	4.03105e-02	0.7128150
23	3 - 2 - 2	0.72709400	0.767419782	0.17822884	0.2451249	6.79900e-02	0.9048870
24	3 - 2 - 3	0.11430400	0.103673499	0.08354339	0.7308877	3.85483e-02	0.2487050
25	3 - 3 - 1	0.00125011	0.010449393	0.06314863	50.5144596	1.06477e-08	0.0262777
26	3 - 3 - 2	0.17041300	0.162785490	0.10533840	0.6181360	2.43950e-02	0.3639660
27	3 - 3 - 3	0.82833700	0.826765120	0.12044686	0.1454080	5.46616e-01	0.9561450
28	4 - 1 - 1	0.85655900	0.765457278	0.24837943	0.2899735	2.77779e-02	0.9799240
29	4 - 1 - 2	0.14129500	0.207834105	0.20900478	1.4792086	1.12050e-02	0.9021850
30	4 - 1 - 3	0.00214524	0.026708617	0.13200380	61.5333479	9.20769e-09	0.1199280
31	4 - 2 - 1	0.13112900	0.158351540	0.19042588	1.4522027	9.18902e-03	0.8112780
32	4 - 2 - 2	0.76152200	0.705919999	0.24931076	0.3273848	3.67854e-02	0.9390300
33	4 - 2 - 3	0.10734900	0.135728436	0.16939033	1.5779404	9.08919e-03	0.7617110
34	4 - 3 - 1	0.00128911	0.036081299	0.15732813	122.0439908	9.16274e-09	0.8089220
35	4 - 3 - 2	0.16675300	0.194295888	0.19808161	1.1878744	1.21631e-02	0.8976770
36	4 - 3 - 3	0.83195800	0.769622819	0.24832395	0.2984814	2.80980e-02	0.9735090
37	5 - 1 - 1	0.84699300	0.794370357	0.17878256	0.2110791	6.93686e-02	0.9678760
38	5 - 1 - 2	0.15080700	0.190871462	0.15410737	1.0218847	2.21000e-02	0.7937670
39	5 - 1 - 3	0.00220055	0.014758183	0.08490844	38.5850973	1.02025e-08	0.0393771
40	5 - 2 - 1	0.11829400	0.141288165	0.16061698	1.3577779	2.20593e-02	0.7087040
41	5 - 2 - 2	0.77793600	0.745544465	0.20391978	0.2621292	7.07388e-02	0.9232780
42	5 - 2 - 3	0.10377000	0.113167369	0.11523366	1.1104719	2.33215e-02	0.4587960
43	5 - 3 - 1	0.00132245	0.014032326	0.08050236	60.8736516	1.12764e-08	0.0389111
44	5 - 3 - 2	0.16596100	0.182739205	0.14842576	0.8943412	1.55882e-02	0.7629640

```
45  5 - 3 - 3 0.83271600 0.803228475 0.16928854   0.2032969 1.05969e-01 0.9632670
46  6 - 1 - 1 0.83764700 0.796137398 0.18171596   0.2169362 7.03935e-02 0.9806260
47  6 - 1 - 2 0.16010800 0.191875457 0.16405258   1.0246370 1.22267e-02 0.8546240
48  6 - 1 - 3 0.00224500 0.011987156 0.06681758  29.7628423 9.36915e-09 0.0471223
49  6 - 2 - 1 0.11417900 0.152421606 0.18583303   1.6275587 1.99000e-02 0.7999660
50  6 - 2 - 2 0.78697900 0.731943075 0.23497826   0.2985826 4.61449e-02 0.9318890
51  6 - 2 - 3 0.09884210 0.115635316 0.13074272   1.3227432 9.76711e-03 0.5566420
52  6 - 3 - 1 0.00148724 0.021540516 0.10882640  73.1733978 1.19113e-08 0.0703360
53  6 - 3 - 2 0.17561000 0.203542310 0.18943108   1.0787032 1.39113e-02 0.8915080
54  6 - 3 - 3 0.82290300 0.774917166 0.21722508   0.2639741 3.99097e-02 0.9716660
55  7 - 1 - 1 0.84412400 0.824807419 0.12746437   0.1510020 5.17515e-01 0.9701110
56  7 - 1 - 2 0.15366200 0.168118143 0.12036124   0.7832857 1.91677e-02 0.4457710
57  7 - 1 - 3 0.00221412 0.007074441 0.03471170  15.6774266 9.42689e-09 0.0265382
58  7 - 2 - 1 0.10232000 0.141217649 0.14862960   1.4525958 3.58492e-02 0.6686860
59  7 - 2 - 2 0.79828200 0.744870035 0.20069219   0.2514051 5.91353e-02 0.9201300
60  7 - 2 - 3 0.09939880 0.113912330 0.11136151   1.1203506 2.42468e-02 0.4829310
61  7 - 3 - 1 0.00137382 0.014296576 0.07732298  56.2831929 1.08757e-08 0.0473910
62  7 - 3 - 2 0.16343300 0.191970743 0.16429847   1.0052955 1.87251e-02 0.8127290
63  7 - 3 - 3 0.83519400 0.793732690 0.18354932   0.2197685 1.16426e-01 0.9663620
64  8 - 1 - 1 0.85276700 0.776072141 0.24313370   0.2851115 2.53982e-02 0.9801640
65  8 - 1 - 2 0.14471100 0.187230920 0.18529217   1.2804291 1.16077e-02 0.8988870
66  8 - 1 - 3 0.00252204 0.036696939 0.16282963  64.5626661 8.69799e-09 0.8411050
67  8 - 2 - 1 0.08360080 0.146887315 0.18528515   2.2163083 5.48397e-03 0.7698240
68  8 - 2 - 2 0.82279200 0.709839050 0.26078631   0.3169529 4.13873e-02 0.9368500
69  8 - 2 - 3 0.09360690 0.143273633 0.18085305   1.9320483 9.47581e-03 0.7835770
70  8 - 3 - 1 0.00125494 0.026075614 0.12435951  99.0959801 9.66458e-09 0.1601320
71  8 - 3 - 2 0.14289200 0.202368989 0.21592582   1.5111120 1.01525e-02 0.8989050
72  8 - 3 - 3 0.85585300 0.771555395 0.25334499   0.2960146 2.80285e-02 0.9828800
73  9 - 1 - 1 0.86122700 0.772798566 0.25259919   0.2933015 2.34965e-02 0.9827680
74  9 - 1 - 2 0.13642200 0.176399923 0.16966419   1.2436718 9.97662e-03 0.8511750
75  9 - 1 - 3 0.00235114 0.050801515 0.19847793  84.4177404 1.00105e-08 0.9163670
76  9 - 2 - 1 0.09416540 0.123137728 0.13215529   1.4034378 4.42634e-03 0.5303950
77  9 - 2 - 2 0.81267500 0.679601326 0.27955457   0.3439931 5.01237e-02 0.9347400
78  9 - 2 - 3 0.09315930 0.197260942 0.24557082   2.6360312 1.24537e-02 0.8674040
79  9 - 3 - 1 0.00127144 0.018369767 0.10152492  79.8503416 9.52348e-09 0.0733371
80  9 - 3 - 2 0.14352600 0.209556942 0.24317870   1.6943181 9.91264e-03 0.9269840
81  9 - 3 - 3 0.85520200 0.772073299 0.26753376   0.3128311 2.87690e-02 0.9863770


Overall CV on movement
0.06107748



=====================================================================
GROWTH PARAMETER FITS
=====================================================================
  parameter observed  expected      RMSE         CV    LR2.5   UP97.5
1  mu_Alpha     5.47 5.4240880 0.1296662 0.02370497 5.197890 5.676240
2   mu_Beta     2.89 2.8834643 2.5887798 0.89577157 2.689240 3.117060
3     theta     1.00 0.9714875 4.4987497 4.49874966 0.841913 1.000000
4     omega     0.80 0.8004788 4.6695330 5.83691620 0.779125 0.820915
```

b. Design scenario: 60% examination of commercial catch; 15000 tags released

```
Mean number of tags released
  stratum     Tags     Cost
1       1 4286.525 64681.81
2       2 7346.591 95829.23
3       3 4788.708 73488.02
      tot     Tags     Cost
1 Total   16421.82 233999.1

Mean number of fish examined
  stratum  Fishexam     Cost
1       1  905999.4 817576.0
2       2 1403510.5 514411.5
3       3 1010917.6 511446.5
       tot    exam    Cost
1 Total    3320427 1843434

Mean number of tags recovered
  stratum     Tags
1       1 124.1406
2       2 211.7787
```

```
3       3 148.4540
       tot     tags
1 Total    484.3733
```

```
=====================================================================
POPULATION FITS
=====================================================================
```

BY STRATUM & LENGTH

Total fits by length bin

numbers

	stock	stratum	length_bin	true_pop	exp_pop	RMSE	CV	LR2.5	UP97.5	bias
1	1	1	1	16967870	11456340	15187931.0	0.8950994	174161.71	45927820	0.6751784
2	1	1	2	3301269	3290000	1722752.3	0.5218455	723127.72	7056121	0.9965865
3	1	1	3	4652575	4585920	1684840.8	0.3621308	2646027.70	7576885	0.9856735
4	1	1	4	1381480	1686542	1742435.3	1.2612816	74116.30	5139929	1.2208227
5	1	1	5	2280736	2557351	1572325.5	0.6893939	1206923.97	5846931	1.1212833
6	1	1	6	1690434	2092473	1671482.6	0.9887890	384440.67	6390526	1.2378319
7	1	1	7	2695764	3108128	2168664.5	0.8044712	1525693.56	6549693	1.1529674
8	1	1	8	1294287	1600247	1652092.9	1.2764502	62283.40	4508326	1.2363930
9	1	1	9	1435985	1424090	805533.4	0.5609625	49474.80	3021506	0.9917165
10	2	2	1	29809355	17269088	15807969.7	0.5303023	1138855.99	40697838	0.5793177
11	2	2	2	5898813	6436580	2309231.7	0.3914740	2131942.05	11654870	1.0911653
12	2	2	3	7762039	8324366	1818686.3	0.2343052	5618542.11	12359709	1.0724458
13	2	2	4	2251332	2608848	1243768.4	0.5524589	742099.49	5384276	1.1588021
14	2	2	5	3837585	4281610	1399907.0	0.3647885	2108780.32	7523704	1.1157043
15	2	2	6	3051663	3472727	1476411.2	0.4838055	1101035.44	6734987	1.1379785
16	2	2	7	4201882	4652536	1504149.6	0.3579705	2347937.47	8068697	1.1072506
17	2	2	8	2048807	2327055	1161948.8	0.5671345	501154.96	5370040	1.1358099
18	2	2	9	2229915	2299896	1172647.6	0.5258709	403994.48	5101418	1.0313826
19	3	3	1	18749189	14874954	35082425.6	1.8711436	244407.23	60094636	0.7933652
20	3	3	2	3765785	3838252	1555094.4	0.4129536	1914168.84	7098157	1.0192434
21	3	3	3	5044362	4891465	976531.8	0.1935888	3410115.59	7027243	0.9696896
22	3	3	4	1396332	1528159	1410364.2	1.0100493	62351.72	4011447	1.0944094
23	3	3	5	2269169	2388286	1225206.6	0.5399363	1078448.52	4434377	1.0524935
24	3	3	6	1616635	1860312	1244611.0	0.7698776	259327.61	4631421	1.1507309
25	3	3	7	2374611	2590281	1602751.8	0.6749533	765732.58	5119630	1.0908230
26	3	3	8	1290950	1622674	1607615.4	1.2452960	65176.96	5342864	1.2569604
27	3	3	9	1943119	2023601	1850075.1	0.9521160	73861.57	6260421	1.0414188

biomass

	stock	stratum	length_bin	true_bio	exp_bio	RMSE_bio	CV_bio	LR2.5	UP97.5	bias
2	1	1	2	1250.8526	1248.4067	653.7673	0.5226573	274.5	2678.5	0.9980446
3	1	1	3	2292.1822	2246.3681	826.1211	0.3604081	1295.7	3711.6	0.9800129
4	1	1	4	824.0626	1006.0323	1039.3749	1.2612815	44.2	3066.0	1.2208202
5	1	1	5	1555.6796	1743.7511	1071.9214	0.6890374	822.8	3987.4	1.1208934
6	1	1	6	1367.3543	1694.9181	1354.4387	0.9905543	311.4	5177.0	1.2395603
7	1	1	7	2839.7450	3279.2683	2288.9633	0.8060454	1608.3	6905.1	1.1547756
8	1	1	8	1964.1889	2416.6852	2492.8371	1.2691433	94.1	6807.2	1.2303731
9	1	1	9	4313.6008	3754.2845	2195.1402	0.5088881	131.3	8061.0	0.8703366
11	2	2	2	2236.2343	2444.3918	877.9585	0.3926058	809.7	4426.6	1.0930840
12	2	2	3	3812.8285	4082.0394	889.7676	0.2333616	2755.3	6062.9	1.0706066
13	2	2	4	1342.9355	1556.1968	741.9189	0.5524605	442.7	3211.8	1.1588023
14	2	2	5	2620.1145	2919.3851	953.4470	0.3638952	1438.0	5128.6	1.1142204
15	2	2	6	2471.0890	2811.7141	1195.3302	0.4837261	891.2	5453.3	1.1378441
16	2	2	7	4395.4781	4877.5933	1579.9542	0.3594499	2464.8	8458.9	1.1096844
17	2	2	8	3086.9274	3520.4085	1761.0750	0.5704945	757.5	8128.8	1.1404248
18	2	2	9	7115.6112	6134.7690	3274.2595	0.4601516	1070.2	13645.7	0.8621563
20	3	3	2	1426.8460	1455.8543	589.8938	0.4134250	725.9	2691.7	1.0203304
21	3	3	3	2477.8967	2395.0392	479.4023	0.1934715	1668.4	3441.7	0.9665614
22	3	3	4	832.9220	911.5568	841.2911	1.0100480	37.2	2392.9	1.0944084
23	3	3	5	1547.2618	1627.8067	835.0714	0.5397092	735.0	3022.1	1.0520564
24	3	3	6	1307.5613	1506.2546	1007.9970	0.7708984	210.0	3750.3	1.1519571
25	3	3	7	2496.4956	2718.1569	1681.6711	0.6736127	802.2	5371.7	1.0887890
26	3	3	8	1957.3738	2446.1115	2421.6118	1.2371739	98.1	8065.2	1.2496905
27	3	3	9	6542.3856	5480.3983	5116.7734	0.7820960	203.7	17108.7	0.8376758

BY STOCK & LENGTH

Total fits by length bin

numbers

	stock	length_bin	true_pop	exp_pop	RMSE	CV	bias
1	1	1	16967870	11456340	15187931.0	0.8950994	0.6751784
4	1	2	3301269	3290000	1722752.3	0.5218455	0.9965865
7	1	3	4652575	4585920	1684840.8	0.3621308	0.9856735
10	1	4	1381480	1686542	1742435.3	1.2612816	1.2208227
13	1	5	2280736	2557351	1572325.5	0.6893939	1.1212833
16	1	6	1690434	2092473	1671482.6	0.9887890	1.2378319
19	1	7	2695764	3108128	2168664.5	0.8044712	1.1529674

```
22     1          8  1294287  1600247  1652092.9 1.2764502 1.2363930
25     1          9  1435985  1424090   805533.4 0.5609625 0.9917165
2      2          1 29809355 17269088 15807969.7 0.5303023 0.5793177
5      2          2  5898813  6436580  2309231.7 0.3914740 1.0911653
8      2          3  7762039  8324366  1818686.3 0.2343052 1.0724458
11     2          4  2251332  2608848  1243768.4 0.5524589 1.1588021
14     2          5  3837585  4281610  1399907.0 0.3647885 1.1157043
17     2          6  3051663  3472727  1476411.2 0.4838055 1.1379785
20     2          7  4201882  4652536  1504149.6 0.3579705 1.1072506
23     2          8  2048807  2327055  1161948.8 0.5671345 1.1358099
26     2          9  2229915  2299896  1172647.6 0.5258709 1.0313826
3      3          1 18749189 14874954 35082425.6 1.8711436 0.7933652
6      3          2  3765785  3838252  1555094.4 0.4129536 1.0192434
9      3          3  5044362  4891465   976531.8 0.1935888 0.9696896
12     3          4  1396332  1528159  1410364.2 1.0100493 1.0944094
15     3          5  2269169  2388286  1225206.6 0.5399363 1.0524935
18     3          6  1616635  1860312  1244611.0 0.7698776 1.1507309
21     3          7  2374611  2590281  1602751.8 0.6749533 1.0908230
24     3          8  1290950  1622674  1607615.4 1.2452960 1.2569604
27     3          9  1943119  2023601  1850075.1 0.9521160 1.0414188


   biomass
   stock length_bin  true_bio   exp_bio      RMSE        CV      bias
1      1          2 1250.8526 1248.4067  653.7673 0.5226573 0.9980446
4      1          3 2292.1822 2246.3681  826.1211 0.3604081 0.9800129
7      1          4  824.0626 1006.0323 1039.3749 1.2612815 1.2208202
10     1          5 1555.6796 1743.7511 1071.9214 0.6890374 1.1208934
13     1          6 1367.3543 1694.9181 1354.4387 0.9905543 1.2395603
16     1          7 2839.7450 3279.2683 2288.9633 0.8060454 1.1547756
19     1          8 1964.1889 2416.6852 2492.8371 1.2691433 1.2303731
22     1          9 4313.6008 3754.2845 2195.1402 0.5088881 0.8703366
2      2          2 2236.2343 2444.3918  877.9585 0.3926058 1.0930840
5      2          3 3812.8285 4082.0394  889.7676 0.2333616 1.0706066
8      2          4 1342.9355 1556.1968  741.9189 0.5524605 1.1588023
11     2          5 2620.1145 2919.3851  953.4470 0.3638952 1.1142204
14     2          6 2471.0890 2811.7141 1195.3302 0.4837261 1.1378441
17     2          7 4395.4781 4877.5933 1579.9542 0.3594499 1.1096844
20     2          8 3086.9274 3520.4085 1761.0750 0.5704945 1.1404248
23     2          9 7115.6112 6134.7690 3274.2595 0.4601516 0.8621563
3      3          2 1426.8460 1455.8543  589.8938 0.4134250 1.0203304
6      3          3 2477.8967 2395.0392  479.4023 0.1934715 0.9665614
9      3          4  832.9220  911.5568  841.2911 1.0100480 1.0944084
12     3          5 1547.2618 1627.8067  835.0714 0.5397092 1.0520564
15     3          6 1307.5613 1506.2546 1007.9970 0.7708984 1.1519571
18     3          7 2496.4956 2718.1569 1681.6711 0.6736127 1.0887890
21     3          8 1957.3738 2446.1115 2421.6118 1.2371739 1.2496905
24     3          9 6542.3856 5480.3983 5116.7734 0.7820960 0.8376758
```

```
STRATUM FITS +25cm
   numbers
  stratum true_pop  exp_pop    RMSE        CV     bias
1       1 18732530 20344752 4710638 0.2514683 1.086065
2       2 31282036 34403618 4394810 0.1404899 1.099788
3       3 19700964 20743029 4121561 0.2092061 1.052894

   biomass
  stratum true_bio  exp_bio     RMSE        CV      bias
1       1 16407.67 17389.71 4630.976 0.2822446 1.0598530
2       2 27081.22 28346.50 4557.327 0.1682837 1.0467217
3       3 18588.74 18541.18 6154.069 0.3310643 0.9974412
```

```
STOCK FITS +25cm
   numbers
  stock true_pop  exp_pop    RMSE        CV     bias
1     1 18732530 20344752 4710638 0.2514683 1.086065
2     2 31282036 34403618 4394810 0.1404899 1.099788
```

```
3     3 19700964 20743029 4121561 0.2092061 1.052894

   biomass
  stock true_bio  exp_bio     RMSE        CV      bias
1     1 16407.67 17389.71 4630.976 0.2822446 1.0598530
2     2 27081.22 28346.50 4557.327 0.1682837 1.0467217
3     3 18588.74 18541.18 6154.069 0.3310643 0.9974412

      ________________________________________

SNA 1 FITS (25 cm +)
   numbers
  true_pop  exp_pop    RMSE        CV     bias
1 69715530 75491399 7647988 0.1097028 1.082849

   biomass
  true_bio  exp_bio     RMSE       CV     bias
1 62077.63 64277.39 8949.175 0.144161 1.035436

      ________________________________________


=====================================================================
TAG RECOVERY FITS
=====================================================================
  release recovery      TagObs     TagExp     RMSE         CV
1       1        1 104.6525336 103.608745 2.830628 0.02704787
2       1        2  27.4736298  22.471072 6.221769 0.22646331
3       1        3   0.1716649   1.075515 1.530084 8.91319924
4       2        1  19.1737332  25.199669 7.127182 0.37171590
5       2        2 161.4839710 159.839966 3.683519 0.02281043
6       2        3  24.5956567  25.099644 3.544474 0.14410976
7       3        1   0.3143744   1.098445 1.531388 4.87122549
8       3        2  22.8210962  23.324605 3.627221 0.15894157
9       3        3 123.6866598 122.601464 2.764439 0.02235034


   rec_stra Length_bin    TagObs    TagExp     RMSE         CV
1         1          1  6.132368  6.585648 1.367608 0.22301470
2         1          2 19.275078 19.987707 2.177484 0.11296886
3         1          3 32.465357 33.596889 2.937017 0.09046617
4         1          4  8.015512  8.504748 1.484998 0.18526558
5         1          5 13.587384 14.284180 1.801147 0.13256026
6         1          6  8.991727  9.454959 1.427026 0.15870436
7         1          7 14.215098 14.897285 1.813151 0.12755107
8         1          8  8.833506  9.324907 1.381747 0.15642114
9         1          9 12.624612 13.270535 1.489526 0.11798588
10        2          1 11.408480 10.715238 1.803697 0.15810143
11        2          2 27.228542 26.611678 2.756512 0.10123612
12        2          3 53.001034 51.965885 3.691130 0.06964260
13        2          4 15.791107 15.277461 1.876020 0.11880229
14        2          5 26.678387 25.970014 2.495400 0.09353639
15        2          6 18.568769 18.109242 2.014411 0.10848383
16        2          7 27.915202 27.305913 2.461517 0.08817836
17        2          8 14.927611 14.359740 1.877164 0.12575110
18        2          9 16.259566 15.320473 2.201154 0.13537595
19        3          1  5.735264  5.969505 1.279517 0.22309644
20        3          2 22.998966 22.901114 1.905496 0.08285136
21        3          3 42.660807 42.563130 2.204086 0.05166537
22        3          4 10.448811 10.463484 1.301795 0.12458786
23        3          5 17.750776 17.758947 1.773873 0.09993212
24        3          6 12.145812 12.136881 1.423495 0.11720045
25        3          7 18.874871 18.799457 1.759816 0.09323594
26        3          8  8.941055  9.005725 1.342249 0.15012196
27        3          9  8.897622  9.178379 1.551446 0.17436637

    TagObs   TagExp     RMSE         CV
1 484.3733 484.3191 10.35117 0.02137022




=====================================================================
PROPORTIONAL MOVEMENT FITS
=====================================================================
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	Lb__Fr__To	true_mm	geo_obs	RMSE	CV	LR2.5	UP97.5
1	1 - 1 - 1	0.85874900	0.745235889	0.246363267	0.28688623	1.22619e-02	0.9743250
2	1 - 1 - 2	0.13905100	0.226261686	0.203789214	1.46557172	1.43790e-02	0.8952150
3	1 - 1 - 3	0.00219992	0.028502444	0.137941812	62.70310385	6.11636e-09	0.1215300
4	1 - 2 - 1	0.15032400	0.143573662	0.172763783	1.14927612	4.12556e-03	0.7488090
5	1 - 2 - 2	0.73855600	0.711516729	0.223960638	0.30324124	5.72475e-02	0.9323030
6	1 - 2 - 3	0.11112000	0.144909602	0.163013231	1.46700172	5.21016e-03	0.6932180
7	1 - 3 - 1	0.00132185	0.030724207	0.150255662	113.67073599	5.15427e-09	0.7677530
8	1 - 3 - 2	0.17721900	0.203420345	0.188197025	1.06194609	1.39956e-02	0.8931730
9	1 - 3 - 3	0.82145900	0.765855437	0.235548287	0.28674381	1.52777e-02	0.9666440
10	2 - 1 - 1	0.86366300	0.760477681	0.184997589	0.21420113	1.44475e-01	0.8829500
11	2 - 1 - 2	0.13411700	0.228904146	0.171146197	1.27609622	1.05540e-01	0.7934110
12	2 - 1 - 3	0.00222005	0.010618157	0.068051136	30.65297434	6.91502e-09	0.0242106
13	2 - 2 - 1	0.17112200	0.117348136	0.109801652	0.64165713	3.97745e-02	0.3959640
14	2 - 2 - 2	0.71157300	0.771817701	0.146645613	0.20608653	2.67017e-01	0.8994260
15	2 - 2 - 3	0.11730500	0.110834177	0.084389183	0.71939971	4.63633e-02	0.2388650
16	2 - 3 - 1	0.00128653	0.007404936	0.049209936	38.25012728	6.31659e-09	0.0195690
17	2 - 3 - 2	0.18045600	0.179537222	0.096915517	0.53705899	7.53111e-02	0.3725530
18	2 - 3 - 3	0.81825700	0.813057837	0.107454911	0.13132171	5.65975e-01	0.9188030
19	3 - 1 - 1	0.86416500	0.793642934	0.104818648	0.12129472	6.31455e-01	0.8826240
20	3 - 1 - 2	0.13369200	0.201141383	0.100827668	0.75417877	1.12780e-01	0.3588020
21	3 - 1 - 3	0.00214275	0.005215694	0.007875514	3.67542382	7.37349e-09	0.0195915
22	3 - 2 - 1	0.15860200	0.111172851	0.079629176	0.50206918	5.90838e-02	0.2099650
23	3 - 2 - 2	0.72709400	0.790348930	0.098141668	0.13497796	6.67135e-01	0.8658280
24	3 - 2 - 3	0.11430400	0.098478213	0.030703708	0.26861447	5.95383e-02	0.1649600
25	3 - 3 - 1	0.00125011	0.006070436	0.033838167	27.06815163	7.06823e-09	0.0180918
26	3 - 3 - 2	0.17041300	0.166060902	0.039448671	0.23148862	9.85461e-02	0.2474460
27	3 - 3 - 3	0.82833700	0.827868664	0.052083383	0.06287705	7.37881e-01	0.8941760
28	4 - 1 - 1	0.85655900	0.774837562	0.189953872	0.22176391	4.02212e-02	0.9409860
29	4 - 1 - 2	0.14129500	0.210838533	0.164934660	1.16730713	4.61296e-02	0.8309260
30	4 - 1 - 3	0.00214524	0.014323933	0.086908967	40.51246788	6.39536e-09	0.0417745
31	4 - 2 - 1	0.13112900	0.129765391	0.128505619	0.97999389	1.39402e-02	0.5849960
32	4 - 2 - 2	0.76152200	0.757488288	0.164284482	0.21573176	1.91719e-01	0.9164920
33	4 - 2 - 3	0.10734900	0.112746304	0.105697068	0.98461157	9.47779e-03	0.4263600
34	4 - 3 - 1	0.00128911	0.022881678	0.124152501	96.30869421	6.95700e-09	0.0427931
35	4 - 3 - 2	0.16675300	0.197733730	0.147237572	0.88296806	4.73638e-02	0.7759830
36	4 - 3 - 3	0.83195800	0.779384599	0.188113299	0.22610913	3.00821e-02	0.9323700
37	5 - 1 - 1	0.84699300	0.797283243	0.124831053	0.14738145	5.98767e-01	0.9111380
38	5 - 1 - 2	0.15080700	0.193013976	0.106619034	0.70698996	8.11734e-02	0.3463550
39	5 - 1 - 3	0.00220055	0.009702785	0.066544326	30.23986084	7.20800e-09	0.0200582
40	5 - 2 - 1	0.11829400	0.116442904	0.095133690	0.80421399	4.19990e-02	0.3261680
41	5 - 2 - 2	0.77793600	0.782048062	0.116341591	0.14955162	3.86472e-01	0.8884150
42	5 - 2 - 3	0.10377000	0.101509016	0.064914501	0.62556135	4.19024e-02	0.1987860
43	5 - 3 - 1	0.00132245	0.010798341	0.070784194	53.52504401	6.76922e-09	0.0230591
44	5 - 3 - 2	0.16596100	0.186554804	0.103632864	0.62444107	7.76870e-02	0.3795870
45	5 - 3 - 3	0.83271600	0.802646849	0.124743180	0.14980279	5.89103e-01	0.9058640
46	6 - 1 - 1	0.83764700	0.785963947	0.151179266	0.18048088	1.33793e-01	0.9270290
47	6 - 1 - 2	0.16010800	0.200500187	0.125445917	0.78350812	5.93129e-02	0.4843650
48	6 - 1 - 3	0.00224500	0.013535847	0.085548781	38.10636125	6.18133e-09	0.0319987
49	6 - 2 - 1	0.11417900	0.120624649	0.109901677	0.96253844	2.89506e-02	0.5052790
50	6 - 2 - 2	0.78697900	0.773407911	0.142505835	0.18107959	2.44862e-01	0.9096780
51	6 - 2 - 3	0.09884210	0.105967446	0.094069672	0.95171664	1.86645e-02	0.3453090
52	6 - 3 - 1	0.00148724	0.013082848	0.079742492	53.61776972	6.69605e-09	0.0332399
53	6 - 3 - 2	0.17561000	0.203786080	0.136540068	0.77751875	6.05190e-02	0.6643270
54	6 - 3 - 3	0.82290300	0.783131062	0.158586099	0.19271542	8.74153e-02	0.9264270
55	7 - 1 - 1	0.84412400	0.812782456	0.099276311	0.11760868	6.92360e-01	0.9164440
56	7 - 1 - 2	0.15366200	0.176340246	0.069493219	0.45224726	7.59103e-02	0.2828400
57	7 - 1 - 3	0.00221412	0.010877306	0.076471273	34.53799817	6.28170e-09	0.0185453
58	7 - 2 - 1	0.10232000	0.120570655	0.090103149	0.88060154	4.90882e-02	0.3064850
59	7 - 2 - 2	0.79828200	0.774821038	0.120097423	0.15044486	3.99023e-01	0.8816240
60	7 - 2 - 3	0.09939880	0.104608322	0.077185293	0.77652138	4.29458e-02	0.2499290
61	7 - 3 - 1	0.00137382	0.012370497	0.077829753	56.65207483	7.39095e-09	0.0246676
62	7 - 3 - 2	0.16343300	0.192936814	0.117253378	0.71744004	8.76442e-02	0.4781000
63	7 - 3 - 3	0.83519400	0.794692674	0.139717197	0.16728712	1.87168e-01	0.9021560
64	8 - 1 - 1	0.85276700	0.784282977	0.190963305	0.22393374	2.70243e-02	0.9515660
65	8 - 1 - 2	0.14471100	0.191368540	0.144592095	0.99917833	3.03213e-02	0.7842760
66	8 - 1 - 3	0.00252204	0.024348487	0.131200177	52.02144967	6.75531e-09	0.0689812
67	8 - 2 - 1	0.08360080	0.123716217	0.119221896	1.42608558	7.88043e-03	0.4480900
68	8 - 2 - 2	0.82279200	0.745375306	0.177779993	0.21606918	1.83088e-01	0.9233490
69	8 - 2 - 3	0.09360690	0.130908461	0.133605893	1.42730817	1.08296e-02	0.5565370
70	8 - 3 - 1	0.00125494	0.018989905	0.110402492	87.97431883	6.31910e-09	0.0487991
71	8 - 3 - 2	0.14289200	0.201014703	0.168400265	1.17851430	3.89649e-02	0.8265380
72	8 - 3 - 3	0.85585300	0.779995398	0.200036101	0.23372717	3.53111e-02	0.9419340
73	9 - 1 - 1	0.86122700	0.787803440	0.188277521	0.21861544	2.57506e-02	0.9417410
74	9 - 1 - 2	0.13642200	0.182031662	0.123376536	0.90437419	3.79441e-02	0.4059860
75	9 - 1 - 3	0.00235114	0.030164885	0.148524283	63.17117780	7.30445e-09	0.7749040
76	9 - 2 - 1	0.09416540	0.115132337	0.081208074	0.86239823	6.22579e-03	0.2944730

```
77  9 - 2 - 2 0.81267500 0.719743076 0.196634327   0.24195936 1.37818e-01 0.9093460
78  9 - 2 - 3 0.09315930 0.165124590 0.171393861   1.83979336 1.64205e-02 0.6429700
79  9 - 3 - 1 0.00127144 0.008552075 0.046332076  36.44063101 5.95231e-09 0.0483982
80  9 - 3 - 2 0.14352600 0.215989562 0.217196460   1.51328999 4.32422e-02 0.9090410
81  9 - 3 - 3 0.85520200 0.775458365 0.229510651   0.26837011 2.92159e-02 0.9521550


Overall CV on movement
0.04533618



=====================================================================
GROWTH PARAMETER FITS
=====================================================================
  parameter observed  expected      RMSE         CV    LR2.5   UP97.5
1  mu_Alpha     5.47 5.4152355 0.1043064 0.01906881 5.221620 5.588740
2   mu_Beta     2.89 2.8787675 2.5925831 0.89708759 2.724480 3.060350
3     theta     1.00 0.9803978 4.4897161 4.48971613 0.888646 1.000000
4     omega     0.80 0.8011338 4.6688732 5.83609149 0.785244 0.817303
```

c. Design scenario: 90% examination of commercial catch; 15000 tags released

```
Mean number of tags released
  stratum     Tags     Cost
1       1 4280.108 64393.77
2       2 7352.390 95703.23
3       3 4793.705 73748.51
      tot    Tags     Cost
1 Total   16426.2 233845.5

Mean number of fish examined
  stratum Fishexam      Cost
1       1  1318613 1212215.0
2       2  2031103  745529.5
3       3  1452380  746774.0
       tot    exam    Cost
1 Total    4802097 2704519

Mean number of tags recovered
  stratum     Tags
1       1 180.4640
2       2 306.7603
3       3 213.5175
       tot     tags
1 Total    700.7418

=====================================================================
POPULATION FITS
=====================================================================

BY STRATUM & LENGTH

Total fits by length bin

   numbers
   stock stratum length_bin true_pop  exp_pop       RMSE        CV      LR2.5   UP97.5      bias
1      1       1          1 16967870 10578168 12809363.4 0.7549188  208435.98 40149658 0.6234235
2      1       1          2  3301269  3148753  1190566.2 0.3606390 1366996.16  5531281 0.9538007
3      1       1          3  4652575  4415223  1075615.7 0.2311872 2926069.00  6331400 0.9489849
4      1       1          4  1381480  1599463  1307131.3 0.9461818  443934.52  4438309 1.1577895
5      1       1          5  2280736  2461667  1230093.6 0.5393406 1379117.88  4681935 1.0793300
6      1       1          6  1690434  2045726  1802629.5 1.0663708  933095.67  4877020 1.2101780
7      1       1          7  2695764  2929461  1258227.1 0.4667423 1658582.26  5346443 1.0866904
8      1       1          8  1294287  1544081  1254066.1 0.9689243   60404.27  3322592 1.1929977
9      1       1          9  1435985  1404651   747303.3 0.5204118   47293.33  2623542 0.9781795
10     2       2          1 29809355 16419211 15182111.5 0.5093069 1646423.39 33444153 0.5508073
11     2       2          2  5898813  6391794  1685446.8 0.2857264 3846031.72 10176769 1.0835729
12     2       2          3  7762039  8404634  1593431.2 0.2052851 6054291.56 11283902 1.0827869
13     2       2          4  2251332  2490402   921323.6 0.4092349  938406.32  4578668 1.1061905
14     2       2          5  3837585  4237983  1156138.9 0.3012673 2502131.77  6560489 1.1043360
15     2       2          6  3051663  3319917  1069274.1 0.3503906 1440933.07  5705141 1.0879044
16     2       2          7  4201882  4592276  1204053.6 0.2865510 2891748.92  7059358 1.0929094
17     2       2          8  2048807  2292631   972719.8 0.4747739  698883.12  4508608 1.1190081
18     2       2          9  2229915  2172943   941159.6 0.4220607  429084.68  4434338 0.9744509
19     3       3          1 18749189 12260346 14059308.1 0.7498622  463735.36 47386332 0.6539134
20     3       3          2  3765785  3738472  1104995.7 0.2934304 2359516.83  5824182 0.9927472
21     3       3          3  5044362  4826111  1072465.2 0.2126067 3582363.14  6468985 0.9567337
22     3       3          4  1396332  1461901   864776.8 0.6193204   65773.02  3037652 1.0469583
```

```
23     3       3          5  2269169  2385831  1099595.6 0.4845807 1398604.90  3701889 1.0514118
24     3       3          6  1616635  1809640  1239332.0 0.7666121  243873.89  3980285 1.1193870
25     3       3          7  2374611  2532830  1110298.5 0.4675706 1480678.06  4057024 1.0666294
26     3       3          8  1290950  1502107  1555982.0 1.2052996   59840.17  4068429 1.1635670
27     3       3          9  1943119  2058142  2024198.1 1.0417260   81543.66  7851513 1.0591947
```

```
   biomass
   stock stratum length_bin  true_bio   exp_bio  RMSE_bio    CV_bio  LR2.5  UP97.5      bias
2      1       1          2 1250.8526 1194.8333  451.5498 0.3609936  518.6  2099.3 0.9552151
3      1       1          3 2292.1822 2162.7635  530.0114 0.2312257 1434.4  3101.3 0.9435391
4      1       1          4  824.0626  954.0897  779.7115 0.9461799  264.8  2647.5 1.1577879
5      1       1          5 1555.6796 1678.5476  838.6861 0.5391123  940.2  3192.7 1.0789803
6      1       1          6 1367.3543 1657.0924 1460.5316 1.0681443  755.8  3951.1 1.2118969
7      1       1          7 2839.7450 3091.2345 1328.1637 0.4677053 1751.0  5646.8 1.0885606
8      1       1          8 1964.1889 2331.9342 1892.4025 0.9634524   91.4  5020.4 1.1872250
9      1       1          9 4313.6008 3700.8458 2057.2290 0.4769169  124.2  6915.2 0.8579481
11     2       2          2 2236.2343 2427.5288  641.2884 0.2867716 1461.2  3865.4 1.0855431
12     2       2          3 3812.8285 4121.5204  778.8967 0.2042832 2970.2  5535.7 1.0809614
13     2       2          4 1342.9355 1485.5416  549.5763 0.4092351  559.8  2731.2 1.1061898
14     2       2          5 2620.1145 2889.6303  787.1171 0.3004132 1706.0  4474.0 1.1028642
15     2       2          6 2471.0890 2687.9693  865.6188 0.3502985 1166.7  4619.5 1.0877671
16     2       2          7 4395.4781 4814.0922 1265.2206 0.2878460 3031.2  7399.5 1.0952375
17     2       2          8 3086.9274 3468.5242 1474.8373 0.4777687 1057.1  6823.0 1.1236170
18     2       2          9 7115.6112 5797.6399 2832.2220 0.3980293 1139.0 11830.0 0.8147775
20     3       3          2 1426.8460 1418.0077  419.0130 0.2936638  895.2  2209.1 0.9938057
21     3       3          3 2477.8967 2363.1127  526.7681 0.2125868 1754.1  3170.9 0.9536768
22     3       3          4  832.9220  872.0332  515.8450 0.6193197   39.2  1812.0 1.0469567
23     3       3          5 1547.2618 1626.1302  749.3710 0.4843208  953.2  2523.0 1.0509729
24     3       3          6 1307.5613 1465.2466 1003.7831 0.7676757  197.4  3223.0 1.1205949
25     3       3          7 2496.4956 2658.1821 1165.0244 0.4666639 1553.5  4263.7 1.0647654
26     3       3          8 1957.3738 2264.1612 2343.5250 1.1972802   90.3  6130.4 1.1567342
27     3       3          9 6542.3856 5576.7173 5557.9195 0.8495249  221.7 21012.0 0.8523981
```

BY STOCK & LENGTH

Total fits by length bin

```
   numbers
   stock length_bin true_pop  exp_pop       RMSE        CV      bias
1      1          1 16967870 10578168 12809363.4 0.7549188 0.6234235
4      1          2  3301269  3148753  1190566.2 0.3606390 0.9538007
7      1          3  4652575  4415223  1075615.7 0.2311872 0.9489849
10     1          4  1381480  1599463  1307131.3 0.9461818 1.1577895
13     1          5  2280736  2461667  1230093.6 0.5393406 1.0793300
16     1          6  1690434  2045726  1802629.5 1.0663708 1.2101780
19     1          7  2695764  2929461  1258227.1 0.4667423 1.0866904
22     1          8  1294287  1544081  1254066.1 0.9689243 1.1929977
25     1          9  1435985  1404651   747303.3 0.5204118 0.9781795
2      2          1 29809355 16419211 15182111.5 0.5093069 0.5508073
5      2          2  5898813  6391794  1685446.8 0.2857264 1.0835729
8      2          3  7762039  8404634  1593431.2 0.2052851 1.0827869
11     2          4  2251332  2490402   921323.6 0.4092349 1.1061905
14     2          5  3837585  4237983  1156138.9 0.3012673 1.1043360
17     2          6  3051663  3319917  1069274.1 0.3503906 1.0879044
20     2          7  4201882  4592276  1204053.6 0.2865510 1.0929094
23     2          8  2048807  2292631   972719.8 0.4747739 1.1190081
26     2          9  2229915  2172943   941159.6 0.4220607 0.9744509
3      3          1 18749189 12260346 14059308.1 0.7498622 0.6539134
6      3          2  3765785  3738472  1104995.7 0.2934304 0.9927472
9      3          3  5044362  4826111  1072465.2 0.2126067 0.9567337
12     3          4  1396332  1461901   864776.8 0.6193204 1.0469583
15     3          5  2269169  2385831  1099595.6 0.4845807 1.0514118
18     3          6  1616635  1809640  1239332.0 0.7666121 1.1193870
21     3          7  2374611  2532830  1110298.5 0.4675706 1.0666294
24     3          8  1290950  1502107  1555982.0 1.2052996 1.1635670
27     3          9  1943119  2058142  2024198.1 1.0417260 1.0591947
```

```
   biomass
   stock length_bin  true_bio   exp_bio      RMSE        CV      bias
1      1          2 1250.8526 1194.8333  451.5498 0.3609936 0.9552151
4      1          3 2292.1822 2162.7635  530.0114 0.2312257 0.9435391
7      1          4  824.0626  954.0897  779.7115 0.9461799 1.1577879
10     1          5 1555.6796 1678.5476  838.6861 0.5391123 1.0789803
13     1          6 1367.3543 1657.0924 1460.5316 1.0681443 1.2118969
```

```
16     1          7 2839.7450 3091.2345 1328.1637 0.4677053 1.0885606
19     1          8 1964.1889 2331.9342 1892.4025 0.9634524 1.1872250
22     1          9 4313.6008 3700.8458 2057.2290 0.4769169 0.8579481
2      2          2 2236.2343 2427.5288  641.2884 0.2867716 1.0855431
5      2          3 3812.8285 4121.5204  778.8967 0.2042832 1.0809614
8      2          4 1342.9355 1485.5416  549.5763 0.4092351 1.1061898
11     2          5 2620.1145 2889.6303  787.1171 0.3004132 1.1028642
14     2          6 2471.0890 2687.9693  865.6188 0.3502985 1.0877671
17     2          7 4395.4781 4814.0922 1265.2206 0.2878460 1.0952375
20     2          8 3086.9274 3468.5242 1474.8373 0.4777687 1.1236170
23     2          9 7115.6112 5797.6399 2832.2220 0.3980293 0.8147775
3      3          2 1426.8460 1418.0077  419.0130 0.2936638 0.9938057
6      3          3 2477.8967 2363.1127  526.7681 0.2125868 0.9536768
9      3          4  832.9220  872.0332  515.8450 0.6193197 1.0469567
12     3          5 1547.2618 1626.1302  749.3710 0.4843208 1.0509729
15     3          6 1307.5613 1465.2466 1003.7831 0.7676757 1.1205949
18     3          7 2496.4956 2658.1821 1165.0244 0.4666639 1.0647654
21     3          8 1957.3738 2264.1612 2343.5250 1.1972802 1.1567342
24     3          9 6542.3856 5576.7173 5557.9195 0.8495249 0.8523981
```

```
STRATUM FITS +25cm
   numbers
  stratum true_pop  exp_pop    RMSE        CV     bias
1       1 18732530 19549025 3572096 0.1906895 1.043587
2       2 31282036 33902581 3462702 0.1106930 1.083772
3       3 19700964 20315036 3689893 0.1872950 1.031170

   biomass
  stratum true_bio  exp_bio     RMSE        CV      bias
1       1 16407.67 16771.34 3675.147 0.2239896 1.0221649
2       2 27081.22 27692.45 3806.077 0.1405431 1.0225702
3       3 18588.74 18243.59 6326.780 0.3403555 0.9814322
```

```
STOCK FITS +25cm
   numbers
  stock true_pop  exp_pop    RMSE        CV     bias
1     1 18732530 19549025 3572096 0.1906895 1.043587
2     2 31282036 33902581 3462702 0.1106930 1.083772
3     3 19700964 20315036 3689893 0.1872950 1.031170

   biomass
  stock true_bio  exp_bio     RMSE        CV      bias
1     1 16407.67 16771.34 3675.147 0.2239896 1.0221649
2     2 27081.22 27692.45 3806.077 0.1405431 1.0225702
3     3 18588.74 18243.59 6326.780 0.3403555 0.9814322
```

```
SNA 1 FITS (25 cm +)
   numbers
  true_pop  exp_pop    RMSE        CV     bias
1 69715530 73766642 6193988 0.0888466 1.058109

   biomass
  true_bio  exp_bio     RMSE        CV     bias
1 62077.63 62707.38 8247.489 0.1328577 1.010145
```

```
================================================================
TAG RECOVERY FITS
================================================================
  release recovery      TagObs     TagExp     RMSE         CV
1       1        1 151.9855967 150.559194 3.788960 0.02492973
2       1        2  39.7952675  32.338341 8.652867 0.21743456
```

```
3       1        3   0.2438272   1.459743 2.113170 8.66666985
4       2        1  28.0534979  36.526983 9.560691 0.34080211
5       2        2 234.4310700 232.978015 3.831627 0.01634437
6       2        3  35.3086420  35.571280 4.395085 0.12447619
7       3        1   0.4248971   1.505042 2.128174 5.00868177
8       3        2  32.5339506  33.397821 4.423880 0.13597733
9       3        3 177.9650206 176.353584 4.485478 0.02520427
```

```
   rec_stra Length_bin    TagObs    TagExp     RMSE         CV
1         1          1  8.670782  9.300769 1.801023 0.20771169
2         1          2 27.848765 28.934537 2.881808 0.10348065
3         1          3 47.084362 49.084170 3.710026 0.07879528
4         1          4 11.596708 12.200605 1.720575 0.14836751
5         1          5 19.716049 20.648488 2.208309 0.11200565
6         1          6 13.138889 13.668446 1.813172 0.13800038
7         1          7 20.818930 21.796713 2.316774 0.11128207
8         1          8 12.723251 13.378425 1.768746 0.13901685
9         1          9 18.866255 19.579065 1.828996 0.09694536
10        2          1 16.986626 16.008202 2.227716 0.13114531
11        2          2 39.632716 38.553005 3.466538 0.08746657
12        2          3 76.601852 74.889121 4.546118 0.05934736
13        2          4 23.157407 22.481373 2.259364 0.09756549
14        2          5 38.239712 37.411486 2.858833 0.07476085
15        2          6 27.166667 26.726350 2.510136 0.09239766
16        2          7 40.164609 39.542474 3.047254 0.07586913
17        2          8 21.389918 20.643179 2.317482 0.10834458
18        2          9 23.420782 22.458988 2.620245 0.11187694
19        3          1  8.523663  8.866880 1.566142 0.18374053
20        3          2 33.028807 33.021216 2.079348 0.06295559
21        3          3 61.775720 61.488073 2.702467 0.04374642
22        3          4 14.734568 14.797938 1.705004 0.11571458
23        3          5 25.310700 25.205028 2.102540 0.08306922
24        3          6 17.491770 17.397788 1.751713 0.10014497
25        3          7 27.163580 26.807594 2.236944 0.08235085
26        3          8 12.882716 12.960147 1.726097 0.13398547
27        3          9 12.605967 12.839942 1.890297 0.14995254

    TagObs TagExp     RMSE         CV
1 700.7418 700.69 12.76944 0.01822274
```

```
======================================================================
PROPORTIONAL MOVEMENT FITS
======================================================================
   Lb__Fr__To    true_mm     geo_obs       RMSE          CV       LR2.5    UP97.5
1   1 - 1 - 1 0.85874900 0.750841924 0.22563890   0.26275302 1.95644e-02 0.9358740
2   1 - 1 - 2 0.13905100 0.218676823 0.17267474   1.24180867 1.95559e-02 0.8375260
3   1 - 1 - 3 0.00219992 0.030481248 0.14635872  66.52910947 4.66997e-09 0.7554590
4   1 - 2 - 1 0.15032400 0.133897125 0.14208746   0.94520811 4.78304e-03 0.6100640
5   1 - 2 - 2 0.73855600 0.732300105 0.18624086   0.25216891 7.47684e-02 0.9116420
6   1 - 2 - 3 0.11112000 0.133802784 0.14092720   1.26824334 9.04339e-03 0.5847160
7   1 - 3 - 1 0.00132185 0.027421943 0.14015090 106.02632447 4.41353e-09 0.2185570
8   1 - 3 - 2 0.17721900 0.189957166 0.14508973   0.81870303 1.78331e-02 0.8200000
9   1 - 3 - 3 0.82145900 0.782620882 0.19498543   0.23736477 3.05243e-02 0.9581520
10  2 - 1 - 1 0.86366300 0.766540631 0.15264371   0.17673990 3.64500e-01 0.8634300
11  2 - 1 - 2 0.13411700 0.226951581 0.14749818   1.09977247 1.29969e-01 0.6010890
12  2 - 1 - 3 0.00222005 0.006507794 0.03147968  14.17971526 5.21348e-09 0.0205698
13  2 - 2 - 1 0.17112200 0.108154120 0.08513450   0.49750765 5.24250e-02 0.1954140
14  2 - 2 - 2 0.71157300 0.787648040 0.11308905   0.15892825 6.24330e-01 0.8698380
15  2 - 2 - 3 0.11730500 0.104197818 0.05573472   0.47512658 5.48253e-02 0.1866830
16  2 - 3 - 1 0.00128653 0.007010058 0.04525963  35.17961163 4.82368e-09 0.0163378
17  2 - 3 - 2 0.18045600 0.172508615 0.04295313   0.23802551 9.93292e-02 0.2734280
18  2 - 3 - 3 0.81825700 0.820481313 0.06150721   0.07516857 7.12469e-01 0.8932340
19  3 - 1 - 1 0.86416500 0.790282756 0.09561793   0.11064778 6.66906e-01 0.8620000
20  3 - 1 - 2 0.13369200 0.203598400 0.08918985   0.66712933 1.33111e-01 0.3253630
21  3 - 1 - 3 0.00214275 0.006118836 0.03085974  14.40193070 5.16561e-09 0.0172878
22  3 - 2 - 1 0.15860200 0.107782938 0.07028174   0.44313273 6.67609e-02 0.1684830
23  3 - 2 - 2 0.72709400 0.792577134 0.09318250   0.12815744 7.11137e-01 0.8493550
24  3 - 2 - 3 0.11430400 0.099639944 0.04298027   0.37601723 6.42036e-02 0.1395100
25  3 - 3 - 1 0.00125011 0.004635013 0.00569022   4.55177565 5.25411e-09 0.0153177
26  3 - 3 - 2 0.17041300 0.170922205 0.03340888   0.19604652 1.15859e-01 0.2430440
27  3 - 3 - 3 0.82833700 0.824442808 0.03372134   0.04070969 7.51806e-01 0.8802980
28  4 - 1 - 1 0.85655900 0.784472073 0.15440875   0.18026633 2.51181e-01 0.9154430
```

```
29  4 - 1 - 2 0.14129500 0.202837455 0.13093367   0.92666880 6.51292e-02 0.5577150
30  4 - 1 - 3 0.00214524 0.012690468 0.08184477  38.15179944 4.97180e-09 0.0243688
31  4 - 2 - 1 0.13112900 0.126452817 0.11018700   0.84029465 3.84696e-02 0.4440580
32  4 - 2 - 2 0.76152200 0.766183055 0.12892390   0.16929767 3.27135e-01 0.9002130
33  4 - 2 - 3 0.10734900 0.107364132 0.08093975   0.75398697 9.54743e-03 0.2406090
34  4 - 3 - 1 0.00128911 0.023673938 0.12689432  98.43560512 4.79217e-09 0.0905331
35  4 - 3 - 2 0.16675300 0.186977682 0.11507545   0.69009521 7.46780e-02 0.4823720
36  4 - 3 - 3 0.83195800 0.789348364 0.16615362   0.19971395 3.16816e-02 0.9057740
37  5 - 1 - 1 0.84699300 0.798521765 0.10495137   0.12391055 6.19254e-01 0.8999910
38  5 - 1 - 2 0.15080700 0.190868207 0.08053972   0.53405824 9.03315e-02 0.3357550
39  5 - 1 - 3 0.00220055 0.010610027 0.07264107  33.01041597 4.93645e-09 0.0174290
40  5 - 2 - 1 0.11829400 0.111626922 0.07493385   0.63345434 5.44608e-02 0.2304570
41  5 - 2 - 2 0.77793600 0.784711411 0.09980455   0.12829403 5.93343e-01 0.8732260
42  5 - 2 - 3 0.10377000 0.103661680 0.06921314   0.66698598 5.28966e-02 0.1778550
43  5 - 3 - 1 0.00132245 0.009622178 0.06628689  50.12431003 5.28863e-09 0.0183542
44  5 - 3 - 2 0.16596100 0.180160190 0.06235441   0.37571724 9.45057e-02 0.3226830
45  5 - 3 - 3 0.83271600 0.810217628 0.08487100   0.10192070 6.54493e-01 0.8940850
46  6 - 1 - 1 0.83764700 0.793947809 0.11716053   0.13986862 5.66000e-01 0.9152370
47  6 - 1 - 2 0.16010800 0.195119234 0.09316812   0.58190799 7.58015e-02 0.3605870
48  6 - 1 - 3 0.00224500 0.010932952 0.07148679  31.84266967 5.09063e-09 0.0206565
49  6 - 2 - 1 0.11417900 0.119469586 0.10267681   0.89926177 4.45187e-02 0.3535850
50  6 - 2 - 2 0.78697900 0.776968302 0.12559496   0.15959125 3.51839e-01 0.8939000
51  6 - 2 - 3 0.09884210 0.103562096 0.07679659   0.77696239 2.98038e-02 0.2379900
52  6 - 3 - 1 0.00148724 0.017501746 0.10279652  69.11898710 5.34495e-09 0.0310784
53  6 - 3 - 2 0.17561000 0.193740654 0.10683264   0.60835168 8.49637e-02 0.4136890
54  6 - 3 - 3 0.82290300 0.788757576 0.14392768   0.17490237 1.18885e-01 0.9022250
55  7 - 1 - 1 0.84412400 0.809723097 0.08983474   0.10642363 7.04795e-01 0.9003480
56  7 - 1 - 2 0.15366200 0.181091223 0.06670259   0.43408646 9.41412e-02 0.2819840
57  7 - 1 - 3 0.00221412 0.009185672 0.06533353  29.50767224 4.83880e-09 0.0153580
58  7 - 2 - 1 0.10232000 0.117008808 0.06929693   0.67725695 5.88358e-02 0.2261360
59  7 - 2 - 2 0.79828200 0.779744998 0.09953362   0.12468479 6.10521e-01 0.8667960
60  7 - 2 - 3 0.09939880 0.103246199 0.07016765   0.70592045 5.29689e-02 0.1876630
61  7 - 3 - 1 0.00137382 0.007332479 0.03884572  28.27570115 5.39103e-09 0.0200418
62  7 - 3 - 2 0.16343300 0.185704233 0.08109914   0.49622254 1.05831e-01 0.3206850
63  7 - 3 - 3 0.83519400 0.806963308 0.09236207   0.11058756 6.57064e-01 0.8884290
64  8 - 1 - 1 0.85276700 0.792115555 0.16439787   0.19278169 3.42349e-02 0.9354370
65  8 - 1 - 2 0.14471100 0.184594690 0.10986763   0.75922098 4.66639e-02 0.3597950
66  8 - 1 - 3 0.00252204 0.023289732 0.12743148  50.52714468 4.93997e-09 0.0636270
67  8 - 2 - 1 0.08360080 0.122174611 0.10927966   1.30716047 9.55862e-03 0.3377630
68  8 - 2 - 2 0.82279200 0.756689281 0.15598109   0.18957536 2.27314e-01 0.9051550
69  8 - 2 - 3 0.09360690 0.121136123 0.11574390   1.23648898 1.05473e-02 0.4543830
70  8 - 3 - 1 0.00125494 0.020489978 0.11410812  90.92715226 4.78120e-09 0.0726285
71  8 - 3 - 2 0.14289200 0.200179320 0.16428295   1.14970015 5.62973e-02 0.8504750
72  8 - 3 - 3 0.85585300 0.779330711 0.19993026   0.23360351 2.81664e-02 0.9250480
73  9 - 1 - 1 0.86122700 0.792911282 0.18389565   0.21352750 2.46292e-02 0.9352950
74  9 - 1 - 2 0.13642200 0.173028924 0.10802875   0.79187189 2.90954e-02 0.3336580
75  9 - 1 - 3 0.00235114 0.034059792 0.16173203  68.78877139 5.60064e-09 0.9069890
76  9 - 2 - 1 0.09416540 0.110740919 0.06768740   0.71881388 5.38383e-03 0.2281390
77  9 - 2 - 2 0.81267500 0.721685534 0.18188529   0.22381062 1.33647e-01 0.8966750
78  9 - 2 - 3 0.09315930 0.167573540 0.17085362   1.83399429 2.09545e-02 0.7748240
79  9 - 3 - 1 0.00127144 0.011001847 0.07017070  55.18994481 4.27674e-09 0.0250394
80  9 - 3 - 2 0.14352600 0.193428119 0.17100460   1.19145382 3.15622e-02 0.8631120
81  9 - 3 - 3 0.85520200 0.795570030 0.18949674   0.22158126 3.56571e-02 0.9620250


Overall CV on movement
0.03912409



================================================================
GROWTH PARAMETER FITS
================================================================
  parameter observed  expected       RMSE         CV    LR2.5   UP97.5
1  mu_Alpha     5.47 5.4119749 0.09575568 0.01750561 5.272530 5.563020
2   mu_Beta     2.89 2.8696363 2.60133519 0.90011598 2.743110 3.027020
3     theta     1.00 0.9853870 4.48468921 4.48468921 0.909571 1.000000
4     omega     0.80 0.8013224 4.66868195 5.83585244 0.787261 0.813423
```

d. Design scenario: 30% examination of commercial catch; 30000 tags released

```
Mean number of tags released
  stratum      Tags     Cost
1       1  8244.476 123260.9
2       2 14127.828 183042.6
```

```
3       3  9055.556 137295.6
      tot     Tags     Cost
1 Total   31427.86 443599.2

Mean number of fish examined
  stratum Fishexam     Cost
1       1 493486.9 422734.5
2       2 778400.6 282301.5
3       3 568395.2 278158.5
       tot    exam     Cost
1 Total    1840283 983194.5

Mean number of tags recovered
  stratum     Tags
1       1 129.1380
2       2 224.2348
3       3 157.1545
       tot     tags
1 Total    510.5273

======================================================================
POPULATION FITS
======================================================================

BY STRATUM & LENGTH

Total fits by length bin

   numbers
   stock stratum length_bin true_pop  exp_pop       RMSE        CV      LR2.5   UP97.5      bias
1      1       1          1 16967870 11978975 34155501.1 2.0129516  154471.19 40691868 0.7059799
2      1       1          2  3301269  3218713  1559759.7 0.4724728  370767.18  6729921 0.9749928
3      1       1          3  4652575  4587870  1371102.3 0.2946975 2781212.42  7330173 0.9860927
4      1       1          4  1381480  1673066  1391435.0 1.0072060  294856.81  4687423 1.2110676
5      1       1          5  2280736  2515509  1322013.7 0.5796435 1295213.47  5462513 1.1029373
6      1       1          6  1690434  2131983  1973737.5 1.1675922   94435.01  5649077 1.2612045
7      1       1          7  2695764  3383584  7961224.0 2.9532346 1607710.71  6686915 1.2551483
8      1       1          8  1294287  1586654  1361155.1 1.0516640   80204.97  4544752 1.2258902
9      1       1          9  1435985  1439518   774630.7 0.5394422   46359.02  3277713 1.0024605
10     2       2          1 29809355 17079424 15752441.1 0.5284395 2438772.02 41116295 0.5729552
11     2       2          2  5898813  6444950  2224330.7 0.3770811 2454277.90 11540891 1.0925843
12     2       2          3  7762039  8485713  1924685.6 0.2479613 5729536.12 12325849 1.0932324
13     2       2          4  2251332  2472912  1086602.3 0.4826486  745962.28  4979633 1.0984218
14     2       2          5  3837585  4260643  1317553.4 0.3433288 2238776.55  7035240 1.1102407
15     2       2          6  3051663  3338841  1381550.7 0.4527206 1002003.67  6296338 1.0941053
16     2       2          7  4201882  4677763  1488111.4 0.3541535 2415989.33  8167459 1.1132542
17     2       2          8  2048807  2333927  1106344.8 0.5399948  616427.36  5066839 1.1391640
18     2       2          9  2229915  2210593  1102365.1 0.4943529  416959.25  4889852 0.9913349
19     3       3          1 18749189 13951465 16149117.5 0.8613235  371242.83 54977325 0.7441103
20     3       3          2  3765785  3920883  1783186.7 0.4735232 2222716.12  7135131 1.0411862
21     3       3          3  5044362  4942365  1089316.9 0.2159474 3421896.71  7104646 0.9797800
22     3       3          4  1396332  1685096  1567739.2 1.1227554  169433.84  4772597 1.2068022
23     3       3          5  2269169  2469238  1160273.4 0.5113208 1234608.46  4725746 1.0881684
24     3       3          6  1616635  1997080  1550770.2 0.9592581  406361.65  5826842 1.2353311
25     3       3          7  2374611  2601568  1568290.6 0.6604410 1089657.39  4634123 1.0955764
26     3       3          8  1290950  1592894  1680184.5 1.3015097   63333.49  4337116 1.2338923
27     3       3          9  1943119  2056759  2011378.2 1.0351284  100033.47  6593204 1.0584833


   biomass
   stock stratum length_bin  true_bio   exp_bio  RMSE_bio    CV_bio  LR2.5  UP97.5      bias
2      1       1          2 1250.8526 1221.3279  591.7406 0.4730698  140.7  2553.4 0.9763964
3      1       1          3 2292.1822 2247.3990  672.5479 0.2934094 1362.8  3586.3 0.9804626
4      1       1          4  824.0626  997.9937  830.0014 1.0072068  175.9  2796.1 1.2110654
5      1       1          5 1555.6796 1715.1454  901.1329 0.5792536  882.6  3723.6 1.1025056
6      1       1          6 1367.3543 1726.8546 1599.1672 1.1695340   76.5  4577.7 1.2629167
7      1       1          7 2839.7450 3569.1228 8410.4236 2.9616827 1695.1  7041.2 1.2568462
8      1       1          8 1964.1889 2395.9539 2053.3312 1.0453838  120.8  6867.4 1.2198184
9      1       1          9 4313.6008 3795.8268 2104.4215 0.4878573  121.6  8705.0 0.8799671
11     2       2          2 2236.2343 2447.3990  845.6331 0.3781505  931.9  4383.3 1.0944287
12     2       2          3 3812.8285 4160.9452  941.3284 0.2468845 2810.5  6041.5 1.0913014
13     2       2          4 1342.9355 1475.1094  648.1673 0.4826496  445.0  2970.4 1.0984216
14     2       2          5 2620.1145 2905.0247  897.2260 0.3424377 1526.8  4797.7 1.1087396
15     2       2          6 2471.0890 2703.2611 1118.4804 0.4526265  811.5  5095.0 1.0939553
16     2       2          7 4395.4781 4903.7331 1562.6608 0.3555155 2529.4  8550.0 1.1156313
17     2       2          8 3086.9274 3530.3896 1676.3557 0.5430499  932.3  7659.5 1.1436581
18     2       2          9 7115.6112 5896.0406 3180.5760 0.4469856 1112.7 12933.1 0.8286063
20     3       3          2 1426.8460 1487.2390  676.4513 0.4740885  843.1  2707.8 1.0423262
21     3       3          3 2477.8967 2420.1232  534.2325 0.2155992 1675.6  3478.1 0.9766845
22     3       3          4  832.9220 1005.1718  935.1680 1.1227559  101.1  2846.9 1.2068019
```

23	3	3	5	1547.2618	1682.9606	790.6936	0.5110277	841.6	3221.2	1.0877025
24	3	3	6	1307.5613	1616.9432	1255.8346	0.9604403	329.0	4717.5	1.2366098
25	3	3	7	2496.4956	2729.7443	1644.2581	0.6586265	1143.5	4870.8	1.0934304
26	3	3	8	1957.3738	2400.8821	2530.7315	1.2929219	95.5	6538.7	1.2265833
27	3	3	9	6542.3856	5565.1063	5543.6156	0.8473386	268.5	17934.6	0.8506234

BY STOCK & LENGTH

Total fits by length bin

numbers

	stock	length_bin	true_pop	exp_pop	RMSE	CV	bias
1	1	1	16967870	11978975	34155501.1	2.0129516	0.7059799
4	1	2	3301269	3218713	1559759.7	0.4724728	0.9749928
7	1	3	4652575	4587870	1371102.3	0.2946975	0.9860927
10	1	4	1381480	1673066	1391435.0	1.0072060	1.2110676
13	1	5	2280736	2515509	1322013.7	0.5796435	1.1029373
16	1	6	1690434	2131983	1973737.5	1.1675922	1.2612045
19	1	7	2695764	3383584	7961224.0	2.9532346	1.2551483
22	1	8	1294287	1586654	1361155.1	1.0516640	1.2258902
25	1	9	1435985	1439518	774630.7	0.5394422	1.0024605
2	2	1	29809355	17079424	15752441.1	0.5284395	0.5729552
5	2	2	5898813	6444950	2224330.7	0.3770811	1.0925843
8	2	3	7762039	8485713	1924685.6	0.2479613	1.0932324
11	2	4	2251332	2472912	1086602.3	0.4826486	1.0984218
14	2	5	3837585	4260643	1317553.4	0.3433288	1.1102407
17	2	6	3051663	3338841	1381550.7	0.4527206	1.0941053
20	2	7	4201882	4677763	1488111.4	0.3541535	1.1132542
23	2	8	2048807	2333927	1106344.8	0.5399948	1.1391640
26	2	9	2229915	2210593	1102365.1	0.4943529	0.9913349
3	3	1	18749189	13951465	16149117.5	0.8613235	0.7441103
6	3	2	3765785	3920883	1783186.7	0.4735232	1.0411862
9	3	3	5044362	4942365	1089316.9	0.2159474	0.9797800
12	3	4	1396332	1685096	1567739.2	1.1227554	1.2068022
15	3	5	2269169	2469238	1160273.4	0.5113208	1.0881684
18	3	6	1616635	1997080	1550770.2	0.9592581	1.2353311
21	3	7	2374611	2601568	1568290.6	0.6604410	1.0955764
24	3	8	1290950	1592894	1680184.5	1.3015097	1.2338923
27	3	9	1943119	2056759	2011378.2	1.0351284	1.0584833

biomass

	stock	length_bin	true_bio	exp_bio	RMSE	CV	bias
1	1	2	1250.8526	1221.3279	591.7406	0.4730698	0.9763964
4	1	3	2292.1822	2247.3990	672.5479	0.2934094	0.9804626
7	1	4	824.0626	997.9937	830.0014	1.0072068	1.2110654
10	1	5	1555.6796	1715.1454	901.1329	0.5792536	1.1025056
13	1	6	1367.3543	1726.8546	1599.1672	1.1695340	1.2629167
16	1	7	2839.7450	3569.1228	8410.4236	2.9616827	1.2568462
19	1	8	1964.1889	2395.9539	2053.3312	1.0453838	1.2198184
22	1	9	4313.6008	3795.8268	2104.4215	0.4878573	0.8799671
2	2	2	2236.2343	2447.3990	845.6331	0.3781505	1.0944287
5	2	3	3812.8285	4160.9452	941.3284	0.2468845	1.0913014
8	2	4	1342.9355	1475.1094	648.1673	0.4826496	1.0984216
11	2	5	2620.1145	2905.0247	897.2260	0.3424377	1.1087396
14	2	6	2471.0890	2703.2611	1118.4804	0.4526265	1.0939553
17	2	7	4395.4781	4903.7331	1562.6608	0.3555155	1.1156313
20	2	8	3086.9274	3530.3896	1676.3557	0.5430499	1.1436581
23	2	9	7115.6112	5896.0406	3180.5760	0.4469856	0.8286063
3	3	2	1426.8460	1487.2390	676.4513	0.4740885	1.0423262
6	3	3	2477.8967	2420.1232	534.2325	0.2155992	0.9766845
9	3	4	832.9220	1005.1718	935.1680	1.1227559	1.2068019
12	3	5	1547.2618	1682.9606	790.6936	0.5110277	1.0877025
15	3	6	1307.5613	1616.9432	1255.8346	0.9604403	1.2366098
18	3	7	2496.4956	2729.7443	1644.2581	0.6586265	1.0934304
21	3	8	1957.3738	2400.8821	2530.7315	1.2929219	1.2265833
24	3	9	6542.3856	5565.1063	5543.6156	0.8473386	0.8506234

STRATUM FITS +25cm

numbers

```
  stratum true_pop  exp_pop    RMSE        CV     bias
1       1 18732530 20536897 8816241 0.4706380 1.096323
2       2 31282036 34225341 4258060 0.1361184 1.094089
3       3 19700964 21265884 4461333 0.2264525 1.079434

   biomass
  stratum true_bio  exp_bio     RMSE        CV     bias
1       1 16407.67 17669.62 9178.275 0.5593895 1.076913
2       2 27081.22 28021.90 4409.702 0.1628325 1.034736
3       3 18588.74 18908.17 6607.549 0.3554597 1.017184
```

```
STOCK FITS +25cm
   numbers
  stock true_pop  exp_pop    RMSE        CV     bias
1     1 18732530 20536897 8816241 0.4706380 1.096323
2     2 31282036 34225341 4258060 0.1361184 1.094089
3     3 19700964 21265884 4461333 0.2264525 1.079434

   biomass
  stock true_bio  exp_bio     RMSE        CV     bias
1     1 16407.67 17669.62 9178.275 0.5593895 1.076913
2     2 27081.22 28021.90 4409.702 0.1628325 1.034736
3     3 18588.74 18908.17 6607.549 0.3554597 1.017184
```

```
SNA 1 FITS (25 cm +)
   numbers
  true_pop  exp_pop     RMSE        CV     bias
1 69715530 76028122 10759214 0.1543302 1.090548

   biomass
  true_bio exp_bio     RMSE        CV     bias
1 62077.63 64599.7 12138.61 0.1955392 1.040628
```

```
======================================================================
TAG RECOVERY FITS
======================================================================
  release recovery      TagObs     TagExp     RMSE         CV
1       1        1 109.1184346 107.996701 2.931119 0.02686181
2       1        2  28.8630278  23.628339 6.494822 0.22502220
3       1        3   0.2193615   1.215337 1.742160 7.94196092
4       2        1  19.7003090  25.935829 7.347302 0.37295365
5       2        2 171.1997940 169.803488 3.605601 0.02106078
6       2        3  26.7878476  27.316488 3.794953 0.14166697
7       3        1   0.3192585   1.174731 1.612976 5.05225587
8       3        2  24.1719876  24.633868 3.732174 0.15440080
9       3        3 130.1472709 128.770877 3.666715 0.02817358


   rec_stra Length_bin    TagObs    TagExp     RMSE         CV
1         1          1  6.341916  6.809327 1.409864 0.22230891
2         1          2 20.279094 21.103055 2.445172 0.12057599
3         1          3 33.712667 35.040951 3.064231 0.09089257
4         1          4  8.380021  8.839364 1.419877 0.16943592
5         1          5 14.268795 14.940463 1.728882 0.12116523
6         1          6  9.258496  9.775496 1.521161 0.16429891
7         1          7 14.610711 15.254866 1.869863 0.12797892
8         1          8  9.026777  9.525883 1.441072 0.15964413
9         1          9 13.259526 13.817858 1.572807 0.11861711
10        2          1 12.417096 11.706009 1.792655 0.14436993
11        2          2 29.060762 28.302345 3.041821 0.10467106
12        2          3 55.585994 54.429580 3.891793 0.07001392
13        2          4 16.981462 16.469979 1.911805 0.11258189
14        2          5 28.072091 27.464326 2.439693 0.08690815
15        2          6 19.968074 19.449439 2.043021 0.10231436
16        2          7 29.304840 28.742658 2.561829 0.08741998
17        2          8 15.717817 15.117046 1.912508 0.12167774
18        2          9 17.126674 16.384313 2.227485 0.13005940
```

19	3	1	6.244078	6.497452	1.294804	0.20736515
20	3	2	24.091658	24.034561	1.872746	0.07773422
21	3	3	45.135942	44.966945	2.582418	0.05721423
22	3	4	10.745623	10.789668	1.327795	0.12356614
23	3	5	18.688980	18.616111	1.810052	0.09685128
24	3	6	12.790937	12.782927	1.563498	0.12223483
25	3	7	20.101957	19.998421	1.888627	0.09395239
26	3	8	9.731205	9.819884	1.400949	0.14396459
27	3	9	9.624099	9.796734	1.583901	0.16457659

	TagObs	TagExp	RMSE	CV
1	510.5273	510.4757	10.8015	0.02115753

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PROPORTIONAL MOVEMENT FITS

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	Lb__Fr__To	true_mm	geo_obs	RMSE	CV	LR2.5	UP97.5
1	1 - 1 - 1	0.85874900	0.742361072	0.253197685	0.29484481	1.16259e-02	0.9495380
2	1 - 1 - 2	0.13905100	0.221427837	0.196522857	1.41331495	1.79827e-02	0.8966590
3	1 - 1 - 3	0.00219992	0.036211080	0.158342520	71.97649003	5.45374e-09	0.7947560
4	1 - 2 - 1	0.15032400	0.139594542	0.155291935	1.03304818	4.19823e-03	0.6821640
5	1 - 2 - 2	0.73855600	0.711795844	0.219035953	0.29657325	1.11860e-01	0.9298260
6	1 - 2 - 3	0.11112000	0.148609613	0.170382411	1.53331903	8.84240e-03	0.7160120
7	1 - 3 - 1	0.00132185	0.021948468	0.115133853	87.10054327	5.12042e-09	0.1117750
8	1 - 3 - 2	0.17721900	0.194159142	0.168070776	0.94837899	2.10900e-02	0.8572300
9	1 - 3 - 3	0.82145900	0.783892395	0.205556508	0.25023344	2.19258e-02	0.9711600
10	2 - 1 - 1	0.86366300	0.757990453	0.189048956	0.21889204	8.68620e-02	0.8834920
11	2 - 1 - 2	0.13411700	0.230663131	0.174438255	1.30064238	1.02919e-01	0.7812020
12	2 - 1 - 3	0.00222005	0.011346393	0.068084883	30.66817528	7.32340e-09	0.0264738
13	2 - 2 - 1	0.17112200	0.112566307	0.105936426	0.61906959	2.57814e-02	0.2848830
14	2 - 2 - 2	0.71157300	0.775317096	0.140323885	0.19720237	3.03078e-01	0.8948490
15	2 - 2 - 3	0.11730500	0.112116593	0.082060013	0.69954403	4.53562e-02	0.2464300
16	2 - 3 - 1	0.00128653	0.007023481	0.041602700	32.33713919	6.18270e-09	0.0186956
17	2 - 3 - 2	0.18045600	0.178877213	0.088950799	0.49292237	7.31649e-02	0.3735320
18	2 - 3 - 3	0.81825700	0.814099320	0.099111187	0.12112476	6.02990e-01	0.9179330
19	3 - 1 - 1	0.86416500	0.794543907	0.102071311	0.11811554	6.24652e-01	0.8754320
20	3 - 1 - 2	0.13369200	0.199903180	0.098482120	0.73663435	1.20319e-01	0.3499030
21	3 - 1 - 3	0.00214275	0.005552901	0.007639053	3.56506969	6.59679e-09	0.0178308
22	3 - 2 - 1	0.15860200	0.107987729	0.072414524	0.45658014	6.29694e-02	0.2025250
23	3 - 2 - 2	0.72709400	0.790256443	0.098084894	0.13489988	6.80388e-01	0.8623670
24	3 - 2 - 3	0.11430400	0.101755813	0.046035334	0.40274474	5.89135e-02	0.1535230
25	3 - 3 - 1	0.00125011	0.006440859	0.034616876	27.69106401	6.72599e-09	0.0173417
26	3 - 3 - 2	0.17041300	0.170862260	0.040299824	0.23648328	1.02359e-01	0.2537970
27	3 - 3 - 3	0.82833700	0.822696884	0.053765020	0.06490718	7.31522e-01	0.8933430
28	4 - 1 - 1	0.85655900	0.791041984	0.161546731	0.18859965	1.68905e-01	0.9340520
29	4 - 1 - 2	0.14129500	0.192666866	0.127824077	0.90466101	5.44746e-02	0.5553300
30	4 - 1 - 3	0.00214524	0.016291176	0.096534448	44.99936970	6.03828e-09	0.0336792
31	4 - 2 - 1	0.13112900	0.132587840	0.122321803	0.93283562	2.19605e-02	0.5554150
32	4 - 2 - 2	0.76152200	0.741868450	0.167979732	0.22058421	2.03497e-01	0.8979500
33	4 - 2 - 3	0.10734900	0.125543706	0.116976312	1.08968237	2.08943e-02	0.4809890
34	4 - 3 - 1	0.00128911	0.015056970	0.091935801	71.31726608	6.04143e-09	0.0331117
35	4 - 3 - 2	0.16675300	0.190938626	0.138852171	0.83268170	4.83291e-02	0.7449600
36	4 - 3 - 3	0.83195800	0.794004395	0.164877268	0.19817980	7.30392e-02	0.9420580
37	5 - 1 - 1	0.84699300	0.802546954	0.110784165	0.13079703	6.39771e-01	0.9094360
38	5 - 1 - 2	0.15080700	0.187212991	0.086930895	0.57643806	8.30552e-02	0.3224260
39	5 - 1 - 3	0.00220055	0.010240058	0.063447724	28.83266644	6.39630e-09	0.0210022
40	5 - 2 - 1	0.11829400	0.111307395	0.076968553	0.65065475	4.60819e-02	0.2489800
41	5 - 2 - 2	0.77793600	0.780947291	0.106812843	0.13730287	5.01311e-01	0.8807500
42	5 - 2 - 3	0.10377000	0.107745297	0.072878067	0.70230381	4.62389e-02	0.2235960
43	5 - 3 - 1	0.00132245	0.008308858	0.049672337	37.56084328	6.87621e-09	0.0224475
44	5 - 3 - 2	0.16596100	0.186676072	0.093992066	0.56635032	7.86997e-02	0.3458620
45	5 - 3 - 3	0.83271600	0.805015065	0.107777545	0.12942894	6.19795e-01	0.9072300
46	6 - 1 - 1	0.83764700	0.783861429	0.167079310	0.19946267	3.45125e-02	0.9263890
47	6 - 1 - 2	0.16010800	0.192667737	0.113992225	0.71197082	5.46720e-02	0.4395190
48	6 - 1 - 3	0.00224500	0.023470859	0.125466901	55.88726090	5.78569e-09	0.0670240
49	6 - 2 - 1	0.11417900	0.123929886	0.117589138	1.02986659	1.12437e-02	0.5613800
50	6 - 2 - 2	0.78697900	0.756984471	0.164162694	0.20859857	2.02973e-01	0.9066230
51	6 - 2 - 3	0.09884210	0.119085644	0.120710624	1.22124706	3.32949e-02	0.5299240
52	6 - 3 - 1	0.00148724	0.011737091	0.071319637	47.95435644	6.49821e-09	0.0327761
53	6 - 3 - 2	0.17561000	0.200322139	0.134177293	0.76406408	5.35036e-02	0.6731180
54	6 - 3 - 3	0.82290300	0.787940752	0.152263316	0.18503191	1.71416e-01	0.9342770
55	7 - 1 - 1	0.84412400	0.814733237	0.093584067	0.11086531	6.86788e-01	0.9201810
56	7 - 1 - 2	0.15366200	0.175450553	0.069900367	0.45489690	7.05263e-02	0.2867820

```
57  7 - 1 - 3 0.00221412 0.009816205 0.067837073 30.63839060 6.20788e-09 0.0177736
58  7 - 2 - 1 0.10232000 0.118194361 0.080320932  0.78499738 5.23179e-02 0.2789640
59  7 - 2 - 2 0.79828200 0.775989108 0.108780749  0.13626857 5.23347e-01 0.8797800
60  7 - 2 - 3 0.09939880 0.105816522 0.077037122  0.77503071 4.36490e-02 0.2102460
61  7 - 3 - 1 0.00137382 0.011316508 0.069660837 50.70594188 7.15083e-09 0.0240037
62  7 - 3 - 2 0.16343300 0.194358708 0.110775203  0.67780193 9.83088e-02 0.4190080
63  7 - 3 - 3 0.83519400 0.794324786 0.128851760  0.15427764 3.70778e-01 0.8937430
64  8 - 1 - 1 0.85276700 0.795663402 0.169258470  0.19848150 4.08956e-02 0.9511120
65  8 - 1 - 2 0.14471100 0.181103630 0.118993938  0.82228675 3.40726e-02 0.3966970
66  8 - 1 - 3 0.00252204 0.023232969 0.126892924 50.31360474 6.19723e-09 0.0338048
67  8 - 2 - 1 0.08360080 0.120730910 0.106194425  1.27025608 1.10689e-02 0.3269840
68  8 - 2 - 2 0.82279200 0.749989966 0.169614113  0.20614458 1.97495e-01 0.9101590
69  8 - 2 - 3 0.09360690 0.129279116 0.130377365  1.39281790 1.62186e-02 0.5475010
70  8 - 3 - 1 0.00125494 0.015421500 0.089782377 71.54316290 6.54421e-09 0.0490264
71  8 - 3 - 2 0.14289200 0.211433613 0.186026621  1.30186869 4.47481e-02 0.8840460
72  8 - 3 - 3 0.85585300 0.773144890 0.209992658  0.24536066 3.31513e-02 0.9461720
73  9 - 1 - 1 0.86122700 0.788043045 0.198298152  0.23025074 3.07183e-02 0.9439350
74  9 - 1 - 2 0.13642200 0.179912881 0.132776794  0.97327992 3.55125e-02 0.6128100
75  9 - 1 - 3 0.00235114 0.032044064 0.151936188 64.62234813 6.44031e-09 0.7478420
76  9 - 2 - 1 0.09416540 0.118654482 0.093801997  0.99614080 6.52653e-03 0.3212450
77  9 - 2 - 2 0.81267500 0.712587658 0.199610379  0.24562141 1.58328e-01 0.9074240
78  9 - 2 - 3 0.09315930 0.168757853 0.169862935  1.82335993 2.15889e-02 0.6892850
79  9 - 3 - 1 0.00127144 0.009335434 0.057296254 45.06406429 5.53282e-09 0.0301930
80  9 - 3 - 2 0.14352600 0.200468968 0.186830596  1.30171952 3.84911e-02 0.9000530
81  9 - 3 - 3 0.85520200 0.790195574 0.199782726  0.23360882 5.62397e-02 0.9518100


Overall CV on movement
0.04365413



================================================================
GROWTH PARAMETER FITS
================================================================
  parameter observed  expected      RMSE         CV    LR2.5   UP97.5
1  mu_Alpha     5.47 5.4158458 0.1002949 0.01833544 5.250440 5.590990
2   mu_Beta     2.89 2.8750691 2.5962347 0.89835110 2.725970 3.042000
3     theta     1.00 0.9815664 4.4885395 4.48853947 0.891654 1.000000
4     omega     0.80 0.8010983 4.6689083 5.83613543 0.785210 0.815851
```

e. Design scenario: 60% examination of commercial catch; 30000 tags released

```
Mean number of tags released
  stratum      Tags     Cost
1       1  8238.987 123276.0
2       2 14127.121 184162.8
3       3  9054.537 137295.3
      tot     Tags     Cost
1 Total   31420.65 444734.1

Mean number of fish examined
  stratum  Fishexam     Cost
1       1  905487.9 817806.5
2       2 1405029.2 514032.5
3       3 1010886.9 512188.0
       tot    exam    Cost
1 Total    3321404 1844027

Mean number of tags recovered
  stratum     Tags
1       1 237.4188
2       2 406.5739
3       3 281.2410
       tot     tags
1 Total    925.2337

================================================================
POPULATION FITS
================================================================

BY STRATUM & LENGTH

Total fits by length bin
```

Numbers

	stock	stratum	length_bin	true_pop	exp_pop	RMSE	CV	LR2.5	UP97.5	bias
1	1	1	1	16967870	9975076	12549339.6	0.7395943	230018.80	31093795	0.5878802
2	1	1	2	3301269	3111217	1157314.7	0.3505666	1893990.93	4895538	0.9424307
3	1	1	3	4652575	4442939	1308502.5	0.2812427	3144730.90	6047998	0.9549419
4	1	1	4	1381480	1566086	1183927.2	0.8569992	708774.76	3560936	1.1336290
5	1	1	5	2280736	2446772	1273104.4	0.5581989	1585184.97	3846215	1.0727994
6	1	1	6	1690434	1946765	1135471.1	0.6717039	1040598.44	3521780	1.1516364
7	1	1	7	2695764	2910478	1343647.1	0.4984290	1789472.77	4577279	1.0796487
8	1	1	8	1294287	1457546	879967.5	0.6798859	65028.67	2713426	1.1261383
9	1	1	9	1435985	1399733	508245.7	0.3539353	584241.26	2312310	0.9747547
10	2	2	1	29809355	16392237	15109650.6	0.5068761	1460644.34	31976951	0.5499024
11	2	2	2	5898813	6449498	1485086.6	0.2517603	4384204.76	9651808	1.0933552
12	2	2	3	7762039	8428767	1395733.1	0.1798153	6468632.34	10851359	1.0858960
13	2	2	4	2251332	2434414	736479.6	0.3271306	1066740.37	4034936	1.0813218
14	2	2	5	3837585	4181297	899754.9	0.2344586	2866203.31	5927807	1.0895646
15	2	2	6	3051663	3329984	887337.9	0.2907719	2140154.00	5251085	1.0912032
16	2	2	7	4201882	4587628	1029303.4	0.2449625	3099274.74	6651472	1.0918030
17	2	2	8	2048807	2179883	731972.4	0.3572677	711490.02	3836687	1.0639771
18	2	2	9	2229915	2124986	750014.4	0.3363421	826508.24	3991880	0.9529448
19	3	3	1	18749189	12889359	14246813.3	0.7598629	380996.55	42963583	0.6874622
20	3	3	2	3765785	3689719	902088.4	0.2395486	2539596.87	5600298	0.9798006
21	3	3	3	5044362	4798977	790695.8	0.1567484	3739216.26	6206664	0.9513546
22	3	3	4	1396332	1447734	833808.9	0.5971423	92921.14	2611561	1.0368120
23	3	3	5	2269169	2319869	907492.1	0.3999227	1462319.41	3544740	1.0223431
24	3	3	6	1616635	1692041	574562.7	0.3554065	906758.18	2836959	1.0466439
25	3	3	7	2374611	2540224	1034462.2	0.4356343	1584548.92	3909362	1.0697431
26	3	3	8	1290950	1588177	1477943.5	1.1448492	617096.13	4196692	1.2302387
27	3	3	9	1943119	1881243	1414866.0	0.7281415	346471.56	4453451	0.9681561

biomass

	stock	stratum	length_bin	true_bio	exp_bio	RMSE_bio	CV_bio	LR2.5	UP97.5	bias
2	1	1	2	1250.8526	1180.5841	438.7845	0.3507883	718.7	1857.6	0.9438235
3	1	1	3	2292.1822	2176.3762	643.1424	0.2805808	1539.7	2962.1	0.9494778
4	1	1	4	824.0626	934.1825	706.2212	0.8569994	422.8	2124.1	1.1336305
5	1	1	5	1555.6796	1668.3681	868.1234	0.5580348	1081.0	2622.0	1.0724369
6	1	1	6	1367.3543	1576.8835	920.1931	0.6729734	843.0	2852.8	1.1532369
7	1	1	7	2839.7450	3070.5692	1417.2881	0.4990899	1886.9	4834.7	1.0812834
8	1	1	8	1964.1889	2201.0872	1326.4654	0.6753248	98.3	4096.7	1.1206087
9	1	1	9	4313.6008	3689.6121	1472.6244	0.3413910	1524.4	6145.1	0.8553439
11	2	2	2	2236.2343	2449.3498	565.5226	0.2528906	1665.0	3665.7	1.0953011
12	2	2	3	3812.8285	4133.2780	681.2806	0.1786811	3171.6	5318.5	1.0840451
13	2	2	4	1342.9355	1452.1450	439.3140	0.3271296	636.3	2406.9	1.0813214
14	2	2	5	2620.1145	2850.9152	612.1170	0.2336222	1954.3	4040.9	1.0880880
15	2	2	6	2471.0890	2696.1067	718.2636	0.2906668	1732.5	4251.6	1.0910601
16	2	2	7	4395.4781	4809.3860	1082.7463	0.2463319	3246.7	6968.1	1.0941668
17	2	2	8	3086.9274	3297.7275	1109.5393	0.3594316	1076.4	5804.1	1.0682880
18	2	2	9	7115.6112	5669.1812	2451.5501	0.3445312	2199.3	10766.5	0.7967244
20	3	3	2	1426.8460	1399.5374	342.0141	0.2396994	963.0	2123.4	0.9808609
21	3	3	3	2477.8967	2349.8589	389.7604	0.1572949	1831.8	3040.5	0.9483281
22	3	3	4	832.9220	863.5827	497.3730	0.5971424	55.4	1557.8	1.0368111
23	3	3	5	1547.2618	1581.1765	618.5149	0.3997480	996.5	2416.1	1.0219192
24	3	3	6	1307.5613	1369.9832	465.3781	0.3559130	733.9	2297.4	1.0477392
25	3	3	7	2496.4956	2665.9343	1085.4713	0.4347980	1663.1	4105.0	1.0678706
26	3	3	8	1957.3738	2393.9414	2225.9178	1.1371960	929.5	6316.4	1.2230374
27	3	3	9	6542.3856	5091.1299	4088.1684	0.6248743	930.9	11992.4	0.7781764

BY STOCK & LENGTH

Total fits by length bin

numbers

	stock	length_bin	true_pop	exp_pop	RMSE	CV	bias
1	1	1	16967870	9975076	12549339.6	0.7395943	0.5878802
4	1	2	3301269	3111217	1157314.7	0.3505666	0.9424307
7	1	3	4652575	4442939	1308502.5	0.2812427	0.9549419
10	1	4	1381480	1566086	1183927.2	0.8569992	1.1336290
13	1	5	2280736	2446772	1273104.4	0.5581989	1.0727994
16	1	6	1690434	1946765	1135471.1	0.6717039	1.1516364
19	1	7	2695764	2910478	1343647.1	0.4984290	1.0796487
22	1	8	1294287	1457546	879967.5	0.6798859	1.1261383
25	1	9	1435985	1399733	508245.7	0.3539353	0.9747547
2	2	1	29809355	16392237	15109650.6	0.5068761	0.5499024
5	2	2	5898813	6449498	1485086.6	0.2517603	1.0933552
8	2	3	7762039	8428767	1395733.1	0.1798153	1.0858960
11	2	4	2251332	2434414	736479.6	0.3271306	1.0813218
14	2	5	3837585	4181297	899754.9	0.2344586	1.0895646

```
17     2          6  3051663  3329984   887337.9 0.2907719 1.0912032
20     2          7  4201882  4587628  1029303.4 0.2449625 1.0918030
23     2          8  2048807  2179883   731972.4 0.3572677 1.0639771
26     2          9  2229915  2124986   750014.4 0.3363421 0.9529448
3      3          1 18749189 12889359 14246813.3 0.7598629 0.6874622
6      3          2  3765785  3689719   902088.4 0.2395486 0.9798006
9      3          3  5044362  4798977   790695.8 0.1567484 0.9513546
12     3          4  1396332  1447734   833808.9 0.5971423 1.0368120
15     3          5  2269169  2319869   907492.1 0.3999227 1.0223431
18     3          6  1616635  1692041   574562.7 0.3554065 1.0466439
21     3          7  2374611  2540224  1034462.2 0.4356343 1.0697431
24     3          8  1290950  1588177  1477943.5 1.1448492 1.2302387
27     3          9  1943119  1881243  1414866.0 0.7281415 0.9681561


   biomass
   stock length_bin  true_bio   exp_bio      RMSE        CV      bias
1      1          2 1250.8526 1180.5841  438.7845 0.3507883 0.9438235
4      1          3 2292.1822 2176.3762  643.1424 0.2805808 0.9494778
7      1          4  824.0626  934.1825  706.2212 0.8569994 1.1336305
10     1          5 1555.6796 1668.3681  868.1234 0.5580348 1.0724369
13     1          6 1367.3543 1576.8835  920.1931 0.6729734 1.1532369
16     1          7 2839.7450 3070.5692 1417.2881 0.4990899 1.0812834
19     1          8 1964.1889 2201.0872 1326.4654 0.6753248 1.1206087
22     1          9 4313.6008 3689.6121 1472.6244 0.3413910 0.8553439
2      2          2 2236.2343 2449.3498  565.5226 0.2528906 1.0953011
5      2          3 3812.8285 4133.2780  681.2806 0.1786811 1.0840451
8      2          4 1342.9355 1452.1450  439.3140 0.3271296 1.0813214
11     2          5 2620.1145 2850.9152  612.1170 0.2336222 1.0880880
14     2          6 2471.0890 2696.1067  718.2636 0.2906668 1.0910601
17     2          7 4395.4781 4809.3860 1082.7463 0.2463319 1.0941668
20     2          8 3086.9274 3297.7275 1109.5393 0.3594316 1.0682880
23     2          9 7115.6112 5669.1812 2451.5501 0.3445312 0.7967244
3      3          2 1426.8460 1399.5374  342.0141 0.2396994 0.9808609
6      3          3 2477.8967 2349.8589  389.7604 0.1572949 0.9483281
9      3          4  832.9220  863.5827  497.3730 0.5971424 1.0368111
12     3          5 1547.2618 1581.1765  618.5149 0.3997480 1.0219192
15     3          6 1307.5613 1369.9832  465.3781 0.3559130 1.0477392
18     3          7 2496.4956 2665.9343 1085.4713 0.4347980 1.0678706
21     3          8 1957.3738 2393.9414 2225.9178 1.1371960 1.2230374
24     3          9 6542.3856 5091.1299 4088.1684 0.6248743 0.7781764
```

```
STRATUM FITS +25cm
   numbers
  stratum true_pop  exp_pop    RMSE         CV     bias
1       1 18732530 19281537 3193959 0.17050334 1.029308
2       2 31282036 33716457 2907001 0.09292876 1.077822
3       3 19700964 19957984 2923036 0.14837020 1.013046

   biomass
  stratum true_bio  exp_bio     RMSE        CV      bias
1       1 16407.67 16497.66 2939.752 0.1791694 1.0054850
2       2 27081.22 27358.09 3206.409 0.1183997 1.0102237
3       3 18588.74 17715.14 4895.047 0.2633339 0.9530039
```

```
STOCK FITS +25cm
   numbers
  stock true_pop  exp_pop    RMSE         CV     bias
1     1 18732530 19281537 3193959 0.17050334 1.029308
2     2 31282036 33716457 2907001 0.09292876 1.077822
3     3 19700964 19957984 2923036 0.14837020 1.013046

   biomass
  stock true_bio  exp_bio     RMSE        CV      bias
1     1 16407.67 16497.66 2939.752 0.1791694 1.0054850
2     2 27081.22 27358.09 3206.409 0.1183997 1.0102237
3     3 18588.74 17715.14 4895.047 0.2633339 0.9530039
```

SNA 1 FITS (25 cm +)

numbers

	true_pop	exp_pop	RMSE	CV	bias
1	69715530	72955978	5214994	0.07480391	1.046481

biomass

	true_bio	exp_bio	RMSE	CV	bias
1	62077.63	61570.9	6548.64	0.1054911	0.9918371

TAG RECOVERY FITS

	release	recovery	TagObs	TagExp	RMSE	CV
1	1	1	201.131334	199.304045	5.116002	0.02543613
2	1	2	52.760083	42.198533	11.777714	0.22323152
3	1	3	0.344364	1.927610	2.739418	7.95500663
4	2	1	35.713547	46.962996	12.468410	0.34912271
5	2	2	310.142709	309.136382	3.661828	0.01180691
6	2	3	47.503619	47.967862	4.963980	0.10449689
7	3	1	0.573940	1.921779	2.634957	4.59099711
8	3	2	43.671148	44.196564	4.759238	0.10897899
9	3	3	233.392968	231.571995	4.263188	0.01826614

	rec_stra	Length_bin	TagObs	TagExp	RMSE	CV
1	1	1	11.67011	12.33086	2.028970	0.17386038
2	1	2	36.89245	38.44514	3.292233	0.08923867
3	1	3	62.39917	65.23410	4.694603	0.07523502
4	1	4	15.33092	16.09619	2.155183	0.14057755
5	1	5	26.15202	27.31931	2.610705	0.09982804
6	1	6	17.18201	17.85866	2.019752	0.11755039
7	1	7	27.05895	28.53176	3.054428	0.11288052
8	1	8	16.59152	17.43333	2.143854	0.12921384
9	1	9	24.14168	24.93948	2.064895	0.08553239
10	2	1	22.13650	21.11688	2.571292	0.11615618
11	2	2	52.09928	50.50907	4.033442	0.07741840
12	2	3	101.67322	98.89667	5.548124	0.05456820
13	2	4	30.79524	29.92287	2.839211	0.09219640
14	2	5	51.30714	50.13087	3.639319	0.07093202
15	2	6	35.88728	35.34934	2.837261	0.07906034
16	2	7	53.30403	52.31347	3.701918	0.06944912
17	2	8	28.50465	27.62154	2.761063	0.09686358
18	2	9	30.86660	29.67077	3.045844	0.09867766
19	3	1	10.92865	11.28359	1.972304	0.18047101
20	3	2	43.10548	43.14094	2.388804	0.05541764
21	3	3	80.61841	80.55959	3.307471	0.04102625
22	3	4	19.42813	19.52360	2.031078	0.10454315
23	3	5	33.72182	33.72971	2.487638	0.07376939
24	3	6	23.38573	23.24314	2.101555	0.08986484
25	3	7	35.87073	35.38551	2.753627	0.07676527
26	3	8	17.05895	17.08920	2.000469	0.11726802
27	3	9	17.12306	17.51218	2.168202	0.12662468

	TagObs	TagExp	RMSE	CV
1	925.2337	925.1878	15.35897	0.0166001

PROPORTIONAL MOVEMENT FITS

	Lb__Fr__To	true_mm	geo_obs	RMSE	CV	LR2.5	UP97.5
1	1 - 1 - 1	0.85874900	0.756701862	0.214716809	0.25003442	1.89338e-02	0.9407900
2	1 - 1 - 2	0.13905100	0.206177217	0.141505842	1.01765426	1.71479e-02	0.5268540
3	1 - 1 - 3	0.00219992	0.037120910	0.164203082	74.64047890	4.09743e-09	0.8229640
4	1 - 2 - 1	0.15032400	0.123464539	0.135997472	0.90469567	3.05099e-03	0.5387810
5	1 - 2 - 2	0.73855600	0.735776300	0.182586533	0.24722097	5.55367e-02	0.9024410
6	1 - 2 - 3	0.11112000	0.140759135	0.147352080	1.32606263	8.78590e-03	0.6100700

7	1 - 3 - 1	0.00132185	0.027094480	0.138304780	104.62970837	3.72279e-09	0.1346870
8	1 - 3 - 2	0.17721900	0.186633296	0.131272006	0.74073325	1.41182e-02	0.7558450
9	1 - 3 - 3	0.82145900	0.786272214	0.184383026	0.22445798	2.64187e-02	0.9438250
10	2 - 1 - 1	0.86366300	0.771263983	0.129996418	0.15051753	5.67635e-01	0.8537910
11	2 - 1 - 2	0.13411700	0.221780274	0.122609947	0.91420138	1.40101e-01	0.4117480
12	2 - 1 - 3	0.00222005	0.006955737	0.031626021	14.24563443	4.53121e-09	0.0199540
13	2 - 2 - 1	0.17112200	0.104930716	0.081494110	0.47623398	5.91595e-02	0.1768150
14	2 - 2 - 2	0.71157300	0.791698169	0.101986989	0.14332611	6.80790e-01	0.8583370
15	2 - 2 - 3	0.11730500	0.103371119	0.040952674	0.34911278	5.99176e-02	0.1728410
16	2 - 3 - 1	0.00128653	0.005725777	0.030601421	23.78601453	4.01336e-09	0.0153571
17	2 - 3 - 2	0.18045600	0.177487224	0.040434867	0.22407051	1.15407e-01	0.2576220
18	2 - 3 - 3	0.81825700	0.816787005	0.047412394	0.05794316	7.33263e-01	0.8805010
19	3 - 1 - 1	0.86416500	0.791781180	0.084121568	0.09734434	6.90200e-01	0.8525850
20	3 - 1 - 2	0.13369200	0.202893867	0.081131615	0.60685467	1.43064e-01	0.3028980
21	3 - 1 - 3	0.00214275	0.005324929	0.005966377	2.78444866	4.45663e-09	0.0157260
22	3 - 2 - 1	0.15860200	0.107057123	0.066266412	0.41781574	7.39458e-02	0.1529250
23	3 - 2 - 2	0.72709400	0.792277966	0.084725096	0.11652564	7.19369e-01	0.8430150
24	3 - 2 - 3	0.11430400	0.100664918	0.031222347	0.27315183	7.13006e-02	0.1403630
25	3 - 3 - 1	0.00125011	0.007342209	0.046352771	37.07895349	4.22543e-09	0.0151272
26	3 - 3 - 2	0.17041300	0.175300346	0.029347456	0.17221372	1.23354e-01	0.2324210
27	3 - 3 - 3	0.82833700	0.817357454	0.053537747	0.06463281	7.60628e-01	0.8718090
28	4 - 1 - 1	0.85655900	0.796648994	0.126621305	0.14782555	5.91729e-01	0.9157830
29	4 - 1 - 2	0.14129500	0.191602305	0.100939844	0.71439077	7.02633e-02	0.3505510
30	4 - 1 - 3	0.00214524	0.011748692	0.076076407	35.46288874	4.20513e-09	0.0182552
31	4 - 2 - 1	0.13112900	0.123635794	0.108886645	0.83037806	4.92580e-02	0.3715530
32	4 - 2 - 2	0.76152200	0.767804878	0.121882604	0.16005132	3.01960e-01	0.8778770
33	4 - 2 - 3	0.10734900	0.108559325	0.070692256	0.65852739	1.25640e-02	0.2138050
34	4 - 3 - 1	0.00128911	0.021887928	0.120561134	93.52276694	4.25983e-09	0.0310203
35	4 - 3 - 2	0.16675300	0.185550666	0.089925422	0.53927319	7.20178e-02	0.3540300
36	4 - 3 - 3	0.83195800	0.792561410	0.144016715	0.17310575	5.59285e-02	0.9045510
37	5 - 1 - 1	0.84699300	0.807695045	0.070929636	0.08374288	7.21305e-01	0.8889250
38	5 - 1 - 2	0.15080700	0.184429681	0.052489940	0.34806037	1.00437e-01	0.2655180
39	5 - 1 - 3	0.00220055	0.007875267	0.052867069	24.02447999	4.15199e-09	0.0169246
40	5 - 2 - 1	0.11829400	0.108378705	0.060449950	0.51101450	6.04526e-02	0.1874680
41	5 - 2 - 2	0.77793600	0.789336262	0.077512063	0.09963810	6.80749e-01	0.8595290
42	5 - 2 - 3	0.10377000	0.102285044	0.053937382	0.51977819	5.71904e-02	0.1706900
43	5 - 3 - 1	0.00132245	0.009706075	0.064564772	48.82208951	4.24275e-09	0.0175761
44	5 - 3 - 2	0.16596100	0.184677248	0.063763768	0.38420935	1.22695e-01	0.2893590
45	5 - 3 - 3	0.83271600	0.805616676	0.086639972	0.10404504	6.85959e-01	0.8713570
46	6 - 1 - 1	0.83764700	0.804997097	0.081231498	0.09697581	6.83713e-01	0.9032680
47	6 - 1 - 2	0.16010800	0.188676059	0.071594398	0.44716315	9.01947e-02	0.3003900
48	6 - 1 - 3	0.00224500	0.006326835	0.030661966	13.65789120	4.09897e-09	0.0168158
49	6 - 2 - 1	0.11417900	0.110524953	0.075148119	0.65816060	5.28744e-02	0.2094740
50	6 - 2 - 2	0.78697900	0.791241917	0.087542056	0.11123811	6.71149e-01	0.8763540
51	6 - 2 - 3	0.09884210	0.098233149	0.044499101	0.45020392	5.21918e-02	0.1622660
52	6 - 3 - 1	0.00148724	0.011528276	0.069916956	47.01121281	4.33164e-09	0.0236555
53	6 - 3 - 2	0.17561000	0.197808220	0.090892356	0.51758075	1.07257e-01	0.3764090
54	6 - 3 - 3	0.82290300	0.790663500	0.114346715	0.13895528	5.60204e-01	0.8815310
55	7 - 1 - 1	0.84412400	0.810176150	0.095921796	0.11363472	7.24632e-01	0.8941820
56	7 - 1 - 2	0.15366200	0.179429266	0.066812416	0.43480116	9.97490e-02	0.2581190
57	7 - 1 - 3	0.00221412	0.010394581	0.069041662	31.18243894	4.11383e-09	0.0163463
58	7 - 2 - 1	0.10232000	0.112631761	0.058164082	0.56845272	6.22206e-02	0.1948510
59	7 - 2 - 2	0.79828200	0.784162762	0.077841400	0.09751116	6.64850e-01	0.8546630
60	7 - 2 - 3	0.09939880	0.103205472	0.057259962	0.57606291	5.86453e-02	0.1698320
61	7 - 3 - 1	0.00137382	0.009518611	0.057473983	41.83516274	4.54278e-09	0.0185213
62	7 - 3 - 2	0.16343300	0.185770574	0.061150452	0.37416221	1.16898e-01	0.2956880
63	7 - 3 - 3	0.83519400	0.804710823	0.084999201	0.10177181	6.91402e-01	0.8737740
64	8 - 1 - 1	0.85276700	0.800863945	0.151923387	0.17815346	3.72607e-02	0.9311850
65	8 - 1 - 2	0.14471100	0.173839135	0.083355426	0.57601306	4.67473e-02	0.2734070
66	8 - 1 - 3	0.00252204	0.025296935	0.133993146	53.12887439	4.28392e-09	0.0805010
67	8 - 2 - 1	0.08360080	0.116823089	0.093116872	1.11382753	9.71921e-03	0.2548730
68	8 - 2 - 2	0.82279200	0.752950672	0.149666583	0.18190087	1.50383e-01	0.8741880
69	8 - 2 - 3	0.09360690	0.130226245	0.120751714	1.28998732	5.12733e-02	0.4227890
70	8 - 3 - 1	0.00125494	0.013965614	0.087848440	70.00210331	3.92218e-09	0.0207750
71	8 - 3 - 2	0.14289200	0.182364935	0.098956844	0.69252893	4.81047e-02	0.3882760
72	8 - 3 - 3	0.85585300	0.803669456	0.130836260	0.15287235	4.85928e-01	0.9312960
73	9 - 1 - 1	0.86122700	0.808294908	0.141895799	0.16476004	3.28647e-01	0.9237960
74	9 - 1 - 2	0.13642200	0.166770212	0.071825238	0.52649307	5.07777e-02	0.2579450
75	9 - 1 - 3	0.00235114	0.024934881	0.133854699	56.93182823	4.68351e-09	0.0285202
76	9 - 2 - 1	0.09416540	0.112014964	0.062041328	0.65885482	3.94031e-02	0.2273070
77	9 - 2 - 2	0.81267500	0.730593737	0.154047442	0.18955602	2.78993e-01	0.8716600
78	9 - 2 - 3	0.09315930	0.157391302	0.139521472	1.49766552	5.95129e-02	0.5458600
79	9 - 3 - 1	0.00127144	0.007248363	0.042229164	33.21365097	3.64476e-09	0.0191770
80	9 - 3 - 2	0.14352600	0.188732732	0.145234793	1.01190581	5.55905e-02	0.7946740
81	9 - 3 - 3	0.85520200	0.804018920	0.155599457	0.18194468	1.84197e-01	0.9375010

```
Overall CV on movement
0.03387951


================================================================
GROWTH PARAMETER FITS
================================================================
  parameter observed  expected       RMSE         CV    LR2.5   UP97.5
1  mu_Alpha     5.47 5.4160074 0.08312688 0.01519687 5.298310 5.540330
2   mu_Beta     2.89 2.8735362 2.59727161 0.89870990 2.760110 3.006590
3     theta     1.00 0.9863038 4.48375655 4.48375655 0.919026 1.000000
4     omega     0.80 0.8012787 4.66872492 5.83590615 0.789242 0.812555
```

f. Design scenario: 90% examination of commercial catch; 30000 tags released

```
Mean number of tags released
  stratum      Tags     Cost
1       1  8238.807 122645.0
2       2 14132.917 183528.3
3       3  9040.669 137163.9
      tot     Tags     Cost
1 Total   31412.39 443337.2

Mean number of fish examined
  stratum Fishexam      Cost
1       1  1318940 1212806.0
2       2  2032620  745546.5
3       3  1453970  746381.0
       tot    exam    Cost
1 Total    4805530 2704734

Mean number of tags recovered
  stratum     Tags
1       1 345.7410
2       2 589.7379
3       3 403.6280
       tot     tags
1 Total    1339.107

================================================================
POPULATION FITS
================================================================

BY STRATUM & LENGTH

Total fits by length bin

   Numbers

   stock stratum length_bin true_pop  exp_pop       RMSE        CV      LR2.5   UP97.5      bias
1      1       1          1 16967870  8708445  9693158.0 0.5712655  321403.90 18659206 0.5132315
2      1       1          2  3301269  3108962  1153239.8 0.3493323 1982053.23  4503613 0.9417476
3      1       1          3  4652575  4331903   687472.3 0.1477617 3326058.79  5714151 0.9310764
4      1       1          4  1381480  1475470   888196.7 0.6429313  831446.16  2634096 1.0680355
5      1       1          5  2280736  2386451   919804.2 0.4032927 1607876.64  3499830 1.0463515
6      1       1          6  1690434  1915552  1293617.4 0.7652575 1103428.21  3221300 1.1331718
7      1       1          7  2695764  2834168   603225.7 0.2237680 1973908.35  4100611 1.0513413
8      1       1          8  1294287  1411699   671123.4 0.5185275   76785.24  2279735 1.0907153
9      1       1          9  1435985  1363111   512778.6 0.3570920   86548.48  2042840 0.9492521
10     2       2          1 29809355 16152259 14503069.2 0.4865274 6210678.12 26474356 0.5418520
11     2       2          2  5898813  6360141  1204341.3 0.2041667 4606894.27  8636501 1.0782069
12     2       2          3  7762039  8428981  1225768.4 0.1579183 6811928.93 10417132 1.0859235
13     2       2          4  2251332  2466819   626410.2 0.2782398 1616796.57  3715128 1.0957155
14     2       2          5  3837585  4153293   760853.1 0.1982635 3111900.02  5432496 1.0822675
15     2       2          6  3051663  3292452   681613.5 0.2233581 2278771.14  4618533 1.0789042
16     2       2          7  4201882  4594877   797310.4 0.1897508 3526296.59  6124370 1.0935283
17     2       2          8  2048807  2170387   579103.5 0.2826541 1093101.60  3339604 1.0593422
18     2       2          9  2229915  2055989   622629.9 0.2792168  903098.17  3575335 0.9220030
19     3       3          1 18749189 11358251 11599800.4 0.6186828 3867608.68 27933561 0.6057996
20     3       3          2  3765785  3691360  1035284.8 0.2749187 2720951.55  5006431 0.9802365
21     3       3          3  5044362  4840037  1034392.9 0.2050592 3835664.42  6069056 0.9594944
22     3       3          4  1396332  1426888   650919.0 0.4661635  768017.18  2315174 1.0218830
23     3       3          5  2269169  2299973   778546.0 0.3430974 1586821.23  3174857 1.0135748
24     3       3          6  1616635  1691851   681671.8 0.4216609 1070259.52  2660411 1.0465261
```

```
25     3       3          7  2374611  2454584   587810.0 0.2475395 1718845.62  3388717 1.0336782
26     3       3          8  1290950  1475992  1004810.7 0.7783496  729638.48  3749714 1.1433373
27     3       3          9  1943119  1870242  1277975.2 0.6576925  669987.88  5571198 0.9624946
```

```
   biomass
   stock stratum length_bin  true_bio   exp_bio  RMSE_bio    CV_bio  LR2.5  UP97.5      bias
2      1       1          2 1250.8526 1179.7434  437.2530 0.3495639  752.6  1709.0 0.9431514
3      1       1          3 2292.1822 2122.0229  343.0673 0.1496684 1629.2  2801.4 0.9257654
4      1       1          4  824.0626  880.1291  529.8158 0.6429315  496.0  1571.3 1.0680366
5      1       1          5 1555.6796 1627.2557  627.1646 0.4031451 1096.5  2386.3 1.0460095
6      1       1          6 1367.3543 1551.6320 1048.2201 0.7666047  894.0  2609.5 1.1347695
7      1       1          7 2839.7450 2990.7690  637.6751 0.2245536 2083.3  4322.1 1.0531822
8      1       1          8 1964.1889 2131.9192 1011.7952 0.5151211  115.8  3445.2 1.0853942
9      1       1          9 4313.6008 3594.1395 1520.8388 0.3525683  229.2  5389.4 0.8332110
11     2       2          2 2236.2343 2415.5395  459.0094 0.2052600 1749.0  3280.0 1.0801817
12     2       2          3 3812.8285 4133.3869  597.5898 0.1567314 3340.9  5108.3 1.0840737
13     2       2          4 1342.9355 1471.4749  373.6572 0.2782391  964.4  2216.1 1.0957152
14     2       2          5 2620.1145 2831.8502  517.3151 0.1974399 2121.5  3703.4 1.0808116
15     2       2          6 2471.0890 2665.7503  551.7663 0.2232887 1845.0  3739.4 1.0787755
16     2       2          7 4395.4781 4816.6756  840.3044 0.1911747 3696.4  6422.2 1.0958252
17     2       2          8 3086.9274 3283.4504  878.8444 0.2846988 1654.4  5053.3 1.0636630
18     2       2          9 7115.6112 5484.4625 2281.7778 0.3206721 2421.3  9574.1 0.7707648
20     3       3          2 1426.8460 1400.1815  392.6159 0.2751635 1032.1  1900.1 0.9813123
21     3       3          3 2477.8967 2369.9511  507.9963 0.2050111 1878.7  2972.5 0.9564366
22     3       3          4  832.9220  851.1491  388.2784 0.4661642  458.1  1381.0 1.0218834
23     3       3          5 1547.2618 1567.6258  530.6027 0.3429301 1081.5  2164.2 1.0131613
24     3       3          6 1307.5613 1369.8691  552.1849 0.4223013  866.8  2154.2 1.0476519
25     3       3          7 2496.4956 2576.0702  616.3811 0.2468985 1804.9  3554.8 1.0318745
26     3       3          8 1957.3738 2224.8821 1512.6380 0.7727895 1098.4  5658.8 1.1366669
27     3       3          9 6542.3856 5066.8835 3750.9778 0.5733349 1812.8 15294.0 0.7744703
```

BY STOCK & LENGTH

Total fits by length bin

```
   numbers
   stock length_bin true_pop  exp_pop       RMSE        CV      bias
1      1          1 16967870  8708445  9693158.0 0.5712655 0.5132315
4      1          2  3301269  3108962  1153239.8 0.3493323 0.9417476
7      1          3  4652575  4331903   687472.3 0.1477617 0.9310764
10     1          4  1381480  1475470   888196.7 0.6429313 1.0680355
13     1          5  2280736  2386451   919804.2 0.4032927 1.0463515
16     1          6  1690434  1915552  1293617.4 0.7652575 1.1331718
19     1          7  2695764  2834168   603225.7 0.2237680 1.0513413
22     1          8  1294287  1411699   671123.4 0.5185275 1.0907153
25     1          9  1435985  1363111   512778.6 0.3570920 0.9492521
2      2          1 29809355 16152259 14503069.2 0.4865274 0.5418520
5      2          2  5898813  6360141  1204341.3 0.2041667 1.0782069
8      2          3  7762039  8428981  1225768.4 0.1579183 1.0859235
11     2          4  2251332  2466819   626410.2 0.2782398 1.0957155
14     2          5  3837585  4153293   760853.1 0.1982635 1.0822675
17     2          6  3051663  3292452   681613.5 0.2233581 1.0789042
20     2          7  4201882  4594877   797310.4 0.1897508 1.0935283
23     2          8  2048807  2170387   579103.5 0.2826541 1.0593422
26     2          9  2229915  2055989   622629.9 0.2792168 0.9220030
3      3          1 18749189 11358251 11599800.4 0.6186828 0.6057996
6      3          2  3765785  3691360  1035284.8 0.2749187 0.9802365
9      3          3  5044362  4840037  1034392.9 0.2050592 0.9594944
12     3          4  1396332  1426888   650919.0 0.4661635 1.0218830
15     3          5  2269169  2299973   778546.0 0.3430974 1.0135748
18     3          6  1616635  1691851   681671.8 0.4216609 1.0465261
21     3          7  2374611  2454584   587810.0 0.2475395 1.0336782
24     3          8  1290950  1475992  1004810.7 0.7783496 1.1433373
27     3          9  1943119  1870242  1277975.2 0.6576925 0.9624946
```

```
   biomass
   stock length_bin  true_bio   exp_bio       RMSE        CV      bias
1      1          2 1250.8526 1179.7434  437.2530 0.3495639 0.9431514
4      1          3 2292.1822 2122.0229  343.0673 0.1496684 0.9257654
7      1          4  824.0626  880.1291  529.8158 0.6429315 1.0680366
10     1          5 1555.6796 1627.2557  627.1646 0.4031451 1.0460095
13     1          6 1367.3543 1551.6320 1048.2201 0.7666047 1.1347695
16     1          7 2839.7450 2990.7690  637.6751 0.2245536 1.0531822
19     1          8 1964.1889 2131.9192 1011.7952 0.5151211 1.0853942
```

```
22     1          9 4313.6008 3594.1395 1520.8388 0.3525683 0.8332110
2      2          2 2236.2343 2415.5395  459.0094 0.2052600 1.0801817
5      2          3 3812.8285 4133.3869  597.5898 0.1567314 1.0840737
8      2          4 1342.9355 1471.4749  373.6572 0.2782391 1.0957152
11     2          5 2620.1145 2831.8502  517.3151 0.1974399 1.0808116
14     2          6 2471.0890 2665.7503  551.7663 0.2232887 1.0787755
17     2          7 4395.4781 4816.6756  840.3044 0.1911747 1.0958252
20     2          8 3086.9274 3283.4504  878.8444 0.2846988 1.0636630
23     2          9 7115.6112 5484.4625 2281.7778 0.3206721 0.7707648
3      3          2 1426.8460 1400.1815  392.6159 0.2751635 0.9813123
6      3          3 2477.8967 2369.9511  507.9963 0.2050111 0.9564366
9      3          4  832.9220  851.1491  388.2784 0.4661642 1.0218834
12     3          5 1547.2618 1567.6258  530.6027 0.3429301 1.0131613
15     3          6 1307.5613 1369.8691  552.1849 0.4223013 1.0476519
18     3          7 2496.4956 2576.0702  616.3811 0.2468985 1.0318745
21     3          8 1957.3738 2224.8821 1512.6380 0.7727895 1.1366669
24     3          9 6542.3856 5066.8835 3750.9778 0.5733349 0.7744703
```

```
STRATUM FITS +25cm
   numbers
  stratum true_pop  exp_pop    RMSE         CV     bias
1       1 18732530 18827317 2487607 0.13279611 1.005060
2       2 31282036 33522939 2397408 0.07663848 1.071635
3       3 19700964 19750926 2573844 0.13064561 1.002536

   biomass
  stratum true_bio  exp_bio     RMSE        CV      bias
1       1 16407.67 16077.61 2413.504 0.1470961 0.9798841
2       2 27081.22 27102.59 2822.140 0.1042102 1.0007892
3       3 18588.74 17426.61 4229.332 0.2275211 0.9374820
```

```
STOCK FITS +25cm
   numbers
  stock true_pop  exp_pop    RMSE         CV     bias
1     1 18732530 18827317 2487607 0.13279611 1.005060
2     2 31282036 33522939 2397408 0.07663848 1.071635
3     3 19700964 19750926 2573844 0.13064561 1.002536

   biomass
  stock true_bio  exp_bio     RMSE        CV      bias
1     1 16407.67 16077.61 2413.504 0.1470961 0.9798841
2     2 27081.22 27102.59 2822.140 0.1042102 1.0007892
3     3 18588.74 17426.61 4229.332 0.2275211 0.9374820
```

```
SNA 1 FITS (25 cm +)
   numbers
  true_pop  exp_pop    RMSE         CV    bias
1 69715530 72101182 4308181 0.06179658 1.03422

   biomass
  true_bio  exp_bio     RMSE         CV      bias
1 62077.63 60606.81 5628.208 0.09066403 0.9763069
```

```
================================================================
TAG RECOVERY FITS
================================================================
  release recovery      TagObs     TagExp      RMSE          CV
1       1        1 292.6855087 291.033325  4.879446 0.016671295
2       1        2  76.7338129  61.178010 16.722066 0.217923039
3       1        3   0.5632066   2.272064  3.418084 6.068970709
4       2        1  52.2322713  68.658298 17.488440 0.334820583
```

```
5       2        2 449.3155190 448.315684  3.764571 0.008378459
6       2        3  68.4480987  69.005207  6.242672 0.091203003
7       3        1   0.8232271   2.295326  3.291664 3.998488826
8       3        2  63.6885920  64.033034  6.272652 0.098489418
9       3        3 334.6166495 332.249462  7.617410 0.022764587
```

```
   rec_stra Length_bin    TagObs    TagExp     RMSE         CV
1         1          1  17.24049  18.10907 2.492239 0.14455726
2         1          2  52.75745  55.39469 4.705012 0.08918195
3         1          3  90.43268  94.85211 6.362609 0.07035741
4         1          4  22.20144  23.36510 2.783000 0.12535222
5         1          5  37.89928  39.75164 3.507275 0.09254200
6         1          6  25.07400  26.15695 2.687606 0.10718696
7         1          7  39.92806  41.54025 3.228143 0.08084899
8         1          8  24.35457  25.56251 2.746468 0.11277013
9         1          9  35.85303  37.25461 2.894394 0.08072940
10        2          1  32.11716  30.91841 3.297327 0.10266558
11        2          2  75.58479  73.06270 5.439974 0.07197181
12        2          3 146.97636 142.85016 7.778955 0.05292657
13        2          4  44.47893  42.95480 3.542254 0.07963893
14        2          5  74.41727  72.69772 4.193688 0.05635370
15        2          6  52.15005  51.24985 3.386520 0.06493801
16        2          7  77.02467  75.91553 4.378433 0.05684455
17        2          8  41.45632  40.24359 3.328393 0.08028674
18        2          9  45.53237  43.63398 4.014327 0.08816424
19        3          1  16.19938  16.52408 2.303412 0.14219137
20        3          2  61.56937  61.45191 3.160477 0.05133197
21        3          3 115.47379 115.17930 4.305799 0.03728810
22        3          4  27.29908  27.64648 2.517451 0.09221745
23        3          5  48.42138  48.28533 3.051429 0.06301822
24        3          6  33.49024  33.30358 2.442103 0.07291985
25        3          7  51.91675  51.41273 2.989534 0.05758323
26        3          8  24.65262  24.63445 2.621921 0.10635467
27        3          9  24.60534  25.08887 2.836476 0.11527886
```

```
    TagObs  TagExp    RMSE         CV
1 1339.107 1339.04 19.7659 0.01476051
```

```
======================================================================
PROPORTIONAL MOVEMENT FITS
======================================================================
   Lb__Fr__To    true_mm     geo_obs        RMSE          CV       LR2.5    UP97.5
1   1 - 1 - 1 0.85874900 0.763229360 0.184500786  0.21484833 2.84125e-02 0.8976710
2   1 - 1 - 2 0.13905100 0.211402763 0.127470076  0.91671456 7.78470e-02 0.4486710
3   1 - 1 - 3 0.00219992 0.025367888 0.131595216 59.81818253 3.34922e-09 0.0857370
4   1 - 2 - 1 0.15032400 0.111577869 0.097042742  0.64555721 8.66015e-03 0.2383980
5   1 - 2 - 2 0.73855600 0.760083072 0.130292664  0.17641542 2.71125e-01 0.8729870
6   1 - 2 - 3 0.11112000 0.128339076 0.108237987  0.97406396 4.49658e-02 0.3620120
7   1 - 3 - 1 0.00132185 0.012152643 0.082031416 62.05803667 3.00382e-09 0.0196002
8   1 - 3 - 2 0.17721900 0.184904940 0.095161180  0.53696940 6.94142e-02 0.3078980
9   1 - 3 - 3 0.82145900 0.802942416 0.125232424  0.15245122 5.28631e-01 0.9200480
10  2 - 1 - 1 0.86366300 0.770927205 0.118410762  0.13710297 5.96554e-01 0.8439830
11  2 - 1 - 2 0.13411700 0.222391118 0.109792966  0.81863572 1.51471e-01 0.3881860
12  2 - 1 - 3 0.00222005 0.006681687 0.043024139 19.37980619 3.48968e-09 0.0152708
13  2 - 2 - 1 0.17112200 0.106916613 0.078786341  0.46041036 6.86532e-02 0.1605000
14  2 - 2 - 2 0.71157300 0.788337639 0.097352329  0.13681285 7.06163e-01 0.8429800
15  2 - 2 - 3 0.11730500 0.104745736 0.046729321  0.39835745 6.69723e-02 0.1557000
16  2 - 3 - 1 0.00128653 0.006672953 0.050651518 39.37064691 3.12441e-09 0.0122478
17  2 - 3 - 2 0.18045600 0.177903263 0.037013410  0.20511044 1.27532e-01 0.2290830
18  2 - 3 - 3 0.81825700 0.815423778 0.057564173  0.07034975 7.58255e-01 0.8667190
19  3 - 1 - 1 0.86416500 0.788895839 0.086582709  0.10019234 6.98129e-01 0.8406490
20  3 - 1 - 2 0.13369200 0.205809746 0.080930754  0.60535225 1.55517e-01 0.2918680
21  3 - 1 - 3 0.00214275 0.005294410 0.029345320 13.69516748 3.57631e-09 0.0138171
22  3 - 2 - 1 0.15860200 0.105304304 0.055809524  0.35188411 7.79284e-02 0.1430940
23  3 - 2 - 2 0.72709400 0.791691098 0.081068356  0.11149639 7.36536e-01 0.8353510
24  3 - 2 - 3 0.11430400 0.103004599 0.044880708  0.39264337 7.37502e-02 0.1359950
25  3 - 3 - 1 0.00125011 0.003938396 0.004535328  3.62794330 3.28632e-09 0.0125068
26  3 - 3 - 2 0.17041300 0.176448546 0.024530597  0.14394792 1.33941e-01 0.2231130
27  3 - 3 - 3 0.82833700 0.819613058 0.025560493  0.03085760 7.71681e-01 0.8613000
28  4 - 1 - 1 0.85655900 0.794212954 0.119464172  0.13946987 6.57396e-01 0.8905110
29  4 - 1 - 2 0.14129500 0.194999323 0.092179235  0.65238851 1.01773e-01 0.3222860
30  4 - 1 - 3 0.00214524 0.010787729 0.074249167 34.61112353 3.15437e-09 0.0164564
```

```
31  4 - 2 - 1 0.13112900 0.113990153 0.074794784  0.57039087 5.66215e-02 0.2004030
32  4 - 2 - 2 0.76152200 0.780862187 0.084684764  0.11120462 6.50424e-01 0.8627190
33  4 - 2 - 3 0.10734900 0.105147652 0.054601934  0.50863943 4.86650e-02 0.1850530
34  4 - 3 - 1 0.00128911 0.015907039 0.099363818 77.07939453 3.09344e-09 0.0193066
35  4 - 3 - 2 0.16675300 0.184541192 0.076807574  0.46060685 1.00509e-01 0.2922300
36  4 - 3 - 3 0.83195800 0.799551761 0.123058784  0.14791466 5.49937e-01 0.8876810
37  5 - 1 - 1 0.84699300 0.805524406 0.074516700  0.08797794 7.24206e-01 0.8789740
38  5 - 1 - 2 0.15080700 0.187371138 0.056117774  0.37211651 1.15488e-01 0.2646740
39  5 - 1 - 3 0.00220055 0.007104450 0.051467609 23.38852060 3.36226e-09 0.0137443
40  5 - 2 - 1 0.11829400 0.106928907 0.047294715  0.39980654 6.59612e-02 0.1564120
41  5 - 2 - 2 0.77793600 0.790482791 0.064677667  0.08314009 7.14939e-01 0.8489250
42  5 - 2 - 3 0.10377000 0.102588308 0.052002429  0.50113163 6.42168e-02 0.1525790
43  5 - 3 - 1 0.00132245 0.009570776 0.068007085 51.42507084 3.28644e-09 0.0137139
44  5 - 3 - 2 0.16596100 0.182575807 0.036910472  0.22240449 1.29346e-01 0.2621210
45  5 - 3 - 3 0.83271600 0.807853408 0.073874734  0.08871540 7.23323e-01 0.8637440
46  6 - 1 - 1 0.83764700 0.803768276 0.070638346  0.08432949 6.89925e-01 0.8809120
47  6 - 1 - 2 0.16010800 0.190313823 0.059862624  0.37388903 1.09119e-01 0.2855920
48  6 - 1 - 3 0.00224500 0.005917901 0.041522956 18.49574874 3.30459e-09 0.0131430
49  6 - 2 - 1 0.11417900 0.110120487 0.078111294  0.68411262 5.86246e-02 0.1698160
50  6 - 2 - 2 0.78697900 0.791718980 0.081890726  0.10405707 7.04468e-01 0.8624460
51  6 - 2 - 3 0.09884210 0.098160540 0.040231727  0.40703027 5.57872e-02 0.1603020
52  6 - 3 - 1 0.00148724 0.011966236 0.084056613 56.51852594 3.45318e-09 0.0148360
53  6 - 3 - 2 0.17561000 0.192226318 0.055882755  0.31822080 1.32881e-01 0.3195640
54  6 - 3 - 3 0.82290300 0.795807429 0.090382648  0.10983390 6.50241e-01 0.8592050
55  7 - 1 - 1 0.84412400 0.819400588 0.048819484  0.05783449 7.58689e-01 0.8864700
56  7 - 1 - 2 0.15366200 0.175834299 0.040175220  0.26145189 1.11634e-01 0.2359770
57  7 - 1 - 3 0.00221412 0.004765087 0.024573679 11.09862125 3.17916e-09 0.0126026
58  7 - 2 - 1 0.10232000 0.107601568 0.022210433  0.21706835 7.37057e-02 0.1581930
59  7 - 2 - 2 0.79828200 0.791827865 0.046741024  0.05855202 7.21398e-01 0.8462940
60  7 - 2 - 3 0.09939880 0.100570575 0.036968973  0.37192575 6.49917e-02 0.1476000
61  7 - 3 - 1 0.00137382 0.005435797 0.026124601 19.01602866 3.59862e-09 0.0148777
62  7 - 3 - 2 0.16343300 0.186943284 0.042867997  0.26229707 1.38195e-01 0.2726210
63  7 - 3 - 3 0.83519400 0.807620912 0.052045795  0.06231581 7.09722e-01 0.8557510
64  8 - 1 - 1 0.85276700 0.803514554 0.143896142  0.16874028 5.86556e-02 0.9102750
65  8 - 1 - 2 0.14471100 0.171727259 0.066817143  0.46172816 7.92819e-02 0.2583210
66  8 - 1 - 3 0.00252204 0.024758187 0.133947812 53.11089928 3.19065e-09 0.0667580
67  8 - 2 - 1 0.08360080 0.110412714 0.065505204  0.78354758 9.54793e-03 0.1834560
68  8 - 2 - 2 0.82279200 0.764489553 0.116974775  0.14216810 5.31935e-01 0.8517010
69  8 - 2 - 3 0.09360690 0.125097716 0.101556498  1.08492534 6.09619e-02 0.3080870
70  8 - 3 - 1 0.00125494 0.009989253 0.071160574 56.70436356 3.14519e-09 0.0150296
71  8 - 3 - 2 0.14289200 0.184910375 0.094085126  0.65843522 8.28603e-02 0.3376950
72  8 - 3 - 3 0.85585300 0.805100352 0.116652161  0.13629930 6.01135e-01 0.9051340
73  9 - 1 - 1 0.86122700 0.810823944 0.146246120  0.16981135 5.63963e-02 0.9162850
74  9 - 1 - 2 0.13642200 0.163205779 0.069433262  0.50895942 6.52214e-02 0.2379520
75  9 - 1 - 3 0.00235114 0.025970273 0.139193852 59.20270689 3.35781e-09 0.0574214
76  9 - 2 - 1 0.09416540 0.106916231 0.047794656  0.50756069 1.55134e-02 0.1801240
77  9 - 2 - 2 0.81267500 0.730172559 0.139545481  0.17171130 3.63993e-01 0.8417370
78  9 - 2 - 3 0.09315930 0.162911206 0.134907038  1.44813280 7.96165e-02 0.5632610
79  9 - 3 - 1 0.00127144 0.006467132 0.047887603 37.66406854 2.71655e-09 0.0127047
80  9 - 3 - 2 0.14352600 0.180960427 0.103770267  0.72300675 8.15716e-02 0.4025910
81  9 - 3 - 3 0.85520200 0.812572452 0.115974625  0.13561080 5.51545e-01 0.9102260


Overall CV on movement
0.02851874



================================================================
GROWTH PARAMETER FITS
================================================================
  parameter observed  expected       RMSE         CV    LR2.5   UP97.5
1  mu_Alpha     5.47 5.4070199 0.08109634 0.01482566 5.304910 5.507270
2   mu_Beta     2.89 2.8660125 2.60457224 0.90123607 2.779330 2.974490
3     theta     1.00 0.9896991 4.48034101 4.48034101 0.936305 1.000000
4     omega     0.80 0.8014043 4.66859826 5.83574782 0.791494 0.810448
```

g. Design scenario: 30% examination of commercial catch; 60000 tags released

```
Mean number of tags released
  stratum     Tags     Cost
1       1 16154.21 241011.3
2       2 27685.99 358938.5
```

```
3       3 17574.11 264918.0
      tot     Tags     Cost
1 Total   61414.31 864867.8

Mean number of fish examined
  stratum Fishexam     Cost
1       1 493982.7 422375.5
2       2 777340.8 282880.5
3       3 568754.4 278029.0
       tot    exam   Cost
1 Total    1840078 983285

Mean number of tags recovered
  stratum     Tags
1       1 254.0959
2       2 438.4288
3       3 307.3314
       tot     tags
1 Total    999.8561

======================================================================
POPULATION FITS
======================================================================

BY STRATUM & LENGTH

Total fits by length bin

   Numbers

   stock stratum length_bin true_pop  exp_pop       RMSE        CV     LR2.5   UP97.5      bias
1      1       1          1 16967870  9277154 11117213.4 0.6551920  242495.5 32679081 0.5467483
2      1       1          2  3301269  3189458  1575101.3 0.4771200 1928086.5  4916971 0.9661308
3      1       1          3  4652575  4401975  1167442.5 0.2509239 3186261.1  5964555 0.9461373
4      1       1          4  1381480  1493429   813056.2 0.5885400  723729.9  3025438 1.0810352
5      1       1          5  2280736  2434463  1090340.6 0.4780652 1470432.5  4056880 1.0674025
6      1       1          6  1690434  1870244   824888.5 0.4879744  988052.1  3213649 1.1063689
7      1       1          7  2695764  2938210  1374966.9 0.5100472 1839767.7  4758359 1.0899357
8      1       1          8  1294287  1451921   711278.6 0.5495524  807665.9  2576026 1.1217925
9      1       1          9  1435985  1344682   509456.6 0.3547786  822542.8  2126745 0.9364180
10     2       2          1 29809355 16338060 15037112.4 0.5044427  938223.9 31700010 0.5480850
11     2       2          2  5898813  6314607  1483278.6 0.2514537 4014555.9  9307096 1.0704877
12     2       2          3  7762039  8481474  1411109.7 0.1817963 6578389.3 10944820 1.0926863
13     2       2          4  2251332  2446680   666537.9 0.2960638 1187197.5  3799416 1.0867698
14     2       2          5  3837585  4135818   888277.4 0.2314678 2876784.3  5681011 1.0777138
15     2       2          6  3051663  3346050   865978.2 0.2837725 2081172.5  5284047 1.0964676
16     2       2          7  4201882  4647615  1067053.6 0.2539466 3170412.3  6830286 1.1060793
17     2       2          8  2048807  2224184   688736.7 0.3361648 1188809.5  3957017 1.0855998
18     2       2          9  2229915  2118760   663865.8 0.2977090 1055960.6  3672923 0.9501529
19     3       3          1 18749189 13427310 15500924.5 0.8267517  255826.7 59776982 0.7161542
20     3       3          2  3765785  3742321  1333987.6 0.3542389 2567408.5  5467992 0.9937691
21     3       3          3  5044362  4820386   694469.0 0.1376723 3814862.0  6293681 0.9555987
22     3       3          4  1396332  1462621   555827.0 0.3980622  833823.8  2750426 1.0474736
23     3       3          5  2269169  2401268  1301893.4 0.5737314 1522339.8  3749739 1.0582145
24     3       3          6  1616635  1711922   648543.9 0.4011690  871439.1  2910691 1.0589416
25     3       3          7  2374611  2494187   940431.7 0.3960361 1547873.7  3737679 1.0503560
26     3       3          8  1290950  1446615   916841.8 0.7102068  701395.2  2959045 1.1205817
27     3       3          9  1943119  1832450  1258062.6 0.6474448  728197.8  3592868 0.9430452


   biomass
   stock stratum length_bin  true_bio   exp_bio  RMSE_bio    CV_bio  LR2.5 UP97.5      bias
2      1       1          2 1250.8526 1210.2451  597.8351 0.4779421  731.9 1864.1 0.9675361
3      1       1          3 2292.1822 2156.3449  574.8939 0.2508064 1561.5 2922.6 0.9407389
4      1       1          4  824.0626  890.8403  484.9938 0.5885399  431.7 1804.7 1.0810347
5      1       1          5 1555.6796 1659.9142  743.2713 0.4777792 1002.4 2766.0 1.0670026
6      1       1          6 1367.3543 1514.8363  668.5194 0.4889145  800.3 2602.0 1.1078594
7      1       1          7 2839.7450 3098.8551 1451.3388 0.5110807 1940.2 5018.1 1.0912441
8      1       1          8 1964.1889 2192.2344 1070.5258 0.5450218 1219.4 3891.0 1.1161016
9      1       1          9 4313.6008 3545.7869 1537.3890 0.3564050 2202.3 5638.2 0.8220016
11     2       2          2 2236.2343 2397.8475  564.3368 0.2523603 1524.9 3534.3 1.0722703
12     2       2          3 3812.8285 4159.0052  688.6131 0.1806043 3226.2 5367.4 1.0907926
13     2       2          4 1342.9355 1459.4625  397.5949 0.2960640  708.2 2266.4 1.0867703
14     2       2          5 2620.1145 2819.9094  604.4759 0.2307059 1961.7 3874.0 1.0762543
15     2       2          6 2471.0890 2709.0769  701.0186 0.2836881 1685.4 4278.1 1.0963089
16     2       2          7 4395.4781 4872.1730 1122.2472 0.2553186 3322.3 7160.6 1.1084512
17     2       2          8 3086.9274 3364.3160 1045.0416 0.3385378 1799.4 5982.0 1.0898591
18     2       2          9 7115.6112 5652.9778 2280.2324 0.3204549 2832.5 9804.7 0.7944473
20     3       3          2 1426.8460 1419.5231  506.0795 0.3546841  974.2 2073.5 0.9948678
21     3       3          3 2477.8967 2360.1760  342.7007 0.1383031 1866.6 3080.8 0.9524917
```

22	3	3	4	832.9220	872.4651	331.5544	0.3980618	497.4	1640.6	1.0474752
23	3	3	5	1547.2618	1636.5770	887.1383	0.5733602	1037.9	2556.2	1.0577247
24	3	3	6	1307.5613	1386.0392	525.2373	0.4016923	705.2	2356.7	1.0600185
25	3	3	7	2496.4956	2616.8981	985.5035	0.3947548	1627.0	3918.6	1.0482286
26	3	3	8	1957.3738	2180.4422	1378.6012	0.7043116	1055.6	4459.9	1.1139631
27	3	3	9	6542.3856	4957.3025	3734.6789	0.5708436	1945.1	9763.6	0.7577209

BY STOCK & LENGTH

Total fits by length bin

numbers

	stock	length_bin	true_pop	exp_pop	RMSE	CV	bias
1	1	1	16967870	9277154	11117213.4	0.6551920	0.5467483
4	1	2	3301269	3189458	1575101.3	0.4771200	0.9661308
7	1	3	4652575	4401975	1167442.5	0.2509239	0.9461373
10	1	4	1381480	1493429	813056.2	0.5885400	1.0810352
13	1	5	2280736	2434463	1090340.6	0.4780652	1.0674025
16	1	6	1690434	1870244	824888.5	0.4879744	1.1063689
19	1	7	2695764	2938210	1374966.9	0.5100472	1.0899357
22	1	8	1294287	1451921	711278.6	0.5495524	1.1217925
25	1	9	1435985	1344682	509456.6	0.3547786	0.9364180
2	2	1	29809355	16338060	15037112.4	0.5044427	0.5480850
5	2	2	5898813	6314607	1483278.6	0.2514537	1.0704877
8	2	3	7762039	8481474	1411109.7	0.1817963	1.0926863
11	2	4	2251332	2446680	666537.9	0.2960638	1.0867698
14	2	5	3837585	4135818	888277.4	0.2314678	1.0777138
17	2	6	3051663	3346050	865978.2	0.2837725	1.0964676
20	2	7	4201882	4647615	1067053.6	0.2539466	1.1060793
23	2	8	2048807	2224184	688736.7	0.3361648	1.0855998
26	2	9	2229915	2118760	663865.8	0.2977090	0.9501529
3	3	1	18749189	13427310	15500924.5	0.8267517	0.7161542
6	3	2	3765785	3742321	1333987.6	0.3542389	0.9937691
9	3	3	5044362	4820386	694469.0	0.1376723	0.9555987
12	3	4	1396332	1462621	555827.0	0.3980622	1.0474736
15	3	5	2269169	2401268	1301893.4	0.5737314	1.0582145
18	3	6	1616635	1711922	648543.9	0.4011690	1.0589416
21	3	7	2374611	2494187	940431.7	0.3960361	1.0503560
24	3	8	1290950	1446615	916841.8	0.7102068	1.1205817
27	3	9	1943119	1832450	1258062.6	0.6474448	0.9430452

biomass

	stock	length_bin	true_bio	exp_bio	RMSE	CV	bias
1	1	2	1250.8526	1210.2451	597.8351	0.4779421	0.9675361
4	1	3	2292.1822	2156.3449	574.8939	0.2508064	0.9407389
7	1	4	824.0626	890.8403	484.9938	0.5885399	1.0810347
10	1	5	1555.6796	1659.9142	743.2713	0.4777792	1.0670026
13	1	6	1367.3543	1514.8363	668.5194	0.4889145	1.1078594
16	1	7	2839.7450	3098.8551	1451.3388	0.5110807	1.0912441
19	1	8	1964.1889	2192.2344	1070.5258	0.5450218	1.1161016
22	1	9	4313.6008	3545.7869	1537.3890	0.3564050	0.8220016
2	2	2	2236.2343	2397.8475	564.3368	0.2523603	1.0722703
5	2	3	3812.8285	4159.0052	688.6131	0.1806043	1.0907926
8	2	4	1342.9355	1459.4625	397.5949	0.2960640	1.0867703
11	2	5	2620.1145	2819.9094	604.4759	0.2307059	1.0762543
14	2	6	2471.0890	2709.0769	701.0186	0.2836881	1.0963089
17	2	7	4395.4781	4872.1730	1122.2472	0.2553186	1.1084512
20	2	8	3086.9274	3364.3160	1045.0416	0.3385378	1.0898591
23	2	9	7115.6112	5652.9778	2280.2324	0.3204549	0.7944473
3	3	2	1426.8460	1419.5231	506.0795	0.3546841	0.9948678
6	3	3	2477.8967	2360.1760	342.7007	0.1383031	0.9524917
9	3	4	832.9220	872.4651	331.5544	0.3980618	1.0474752
12	3	5	1547.2618	1636.5770	887.1383	0.5733602	1.0577247
15	3	6	1307.5613	1386.0392	525.2373	0.4016923	1.0600185
18	3	7	2496.4956	2616.8981	985.5035	0.3947548	1.0482286
21	3	8	1957.3738	2180.4422	1378.6012	0.7043116	1.1139631
24	3	9	6542.3856	4957.3025	3734.6789	0.5708436	0.7577209

STRATUM FITS +25cm

```
   numbers
  stratum true_pop  exp_pop    RMSE         CV     bias
1       1 18732530 19124381 3005030 0.16041775 1.020918
2       2 31282036 33715187 2868493 0.09169778 1.077781
3       3 19700964 19911769 2827370 0.14351430 1.010700

   biomass
  stratum true_bio  exp_bio     RMSE        CV      bias
1       1 16407.67 16269.06 2745.628 0.1673381 0.9915522
2       2 27081.22 27434.77 3059.179 0.1129631 1.0130552
3       3 18588.74 17429.42 4285.553 0.2305456 0.9376332
```

```
STOCK FITS +25cm
   numbers
  stock true_pop  exp_pop    RMSE         CV     bias
1     1 18732530 19124381 3005030 0.16041775 1.020918
2     2 31282036 33715187 2868493 0.09169778 1.077781
3     3 19700964 19911769 2827370 0.14351430 1.010700

   biomass
  stock true_bio  exp_bio     RMSE        CV      bias
1     1 16407.67 16269.06 2745.628 0.1673381 0.9915522
2     2 27081.22 27434.77 3059.179 0.1129631 1.0130552
3     3 18588.74 17429.42 4285.553 0.2305456 0.9376332
```

```
SNA 1 FITS (25 cm +)
   numbers
  true_pop  exp_pop    RMSE         CV     bias
1 69715530 72751337 5025185 0.07208128 1.043546

   biomass
  true_bio  exp_bio     RMSE         CV      bias
1 62077.63 61133.25 5938.267 0.09565872 0.9847871
```

```
======================================================================
TAG RECOVERY FITS
======================================================================
  release recovery      TagObs     TagExp      RMSE         CV
1       1        1 216.1191860 213.357337  6.555719 0.03033381
2       1        2  57.4287791  45.489085 13.258121 0.23086197
3       1        3   0.4273256   2.454439  3.207734 7.50653377
4       2        1  37.3938953  49.879723 13.698392 0.36632696
5       2        2 334.1366279 333.354148  4.509065 0.01349468
6       2        3  52.9433140  53.175879  5.653150 0.10677741
7       3        1   0.5828488   2.337480  2.909126 4.99121822
8       3        2  46.8633721  47.619403  5.503258 0.11743197
9       3        3 253.9607558 252.158340  4.765401 0.01876432


   rec_stra Length_bin    TagObs    TagExp     RMSE         CV
1         1          1  12.50727  13.28537 2.179784 0.17428143
2         1          2  39.52326  40.82533 3.468052 0.08774713
3         1          3  66.68314  69.58137 4.950959 0.07424605
4         1          4  16.40116  17.32799 2.130226 0.12988264
5         1          5  28.04506  29.28900 2.924616 0.10428275
6         1          6  18.35465  19.16798 2.164427 0.11792252
7         1          7  28.64680  30.18984 3.125906 0.10911886
8         1          8  17.52616  18.40090 1.994258 0.11378750
9         1          9  26.40843  27.50677 2.288528 0.08665898
10        2          1  24.21657  23.11727 2.741540 0.11320928
11        2          2  56.14971  54.88178 4.225888 0.07526109
12        2          3 108.98837 106.08225 5.994321 0.05499963
13        2          4  33.09738  32.11218 2.871182 0.08674952
14        2          5  55.41860  54.24784 3.622299 0.06536251
15        2          6  38.82413  38.28336 2.951323 0.07601774
16        2          7  57.48256  56.12034 3.814627 0.06636146
17        2          8  30.59593  29.51630 2.844785 0.09297921
```

18	2	9	33.65552	32.10133	3.357249	0.09975329
19	3	1	12.46076	12.77582	2.060217	0.16533646
20	3	2	47.49419	47.45768	2.753291	0.05797112
21	3	3	88.57558	88.58274	3.225924	0.03642002
22	3	4	21.20494	21.25852	1.930869	0.09105748
23	3	5	36.65407	36.57987	2.710514	0.07394850
24	3	6	25.64244	25.36722	2.176847	0.08489235
25	3	7	38.98983	38.80921	2.678096	0.06868705
26	3	8	18.15116	18.34970	1.926927	0.10615998
27	3	9	18.15843	18.60790	2.232405	0.12294042

	TagObs	TagExp	RMSE	CV
1	999.8561	999.8258	16.03943	0.01604174

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PROPORTIONAL MOVEMENT FITS

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	Lb__Fr__To	true_mm	geo_obs	RMSE	CV	LR2.5	UP97.5
1	1 - 1 - 1	0.85874900	0.727772236	0.258217980	0.30069087	1.87584e-02	0.9208250
2	1 - 1 - 2	0.13905100	0.204870886	0.129124607	0.92861329	1.67910e-02	0.4691830
3	1 - 1 - 3	0.00219992	0.067356888	0.225513104	102.50968411	4.78466e-09	0.9111240
4	1 - 2 - 1	0.15032400	0.118545745	0.134767505	0.89651356	2.79026e-03	0.6385220
5	1 - 2 - 2	0.73855600	0.732949431	0.189308099	0.25632193	4.51447e-02	0.8963240
6	1 - 2 - 3	0.11112000	0.148504772	0.173734197	1.56348270	7.85101e-03	0.8459450
7	1 - 3 - 1	0.00132185	0.028182703	0.136377007	103.17131795	4.34863e-09	0.1282740
8	1 - 3 - 2	0.17721900	0.190865150	0.135023392	0.76190133	1.41667e-02	0.8165040
9	1 - 3 - 3	0.82145900	0.780952119	0.189232213	0.23036112	1.97554e-02	0.9726880
10	2 - 1 - 1	0.86366300	0.776328151	0.125977672	0.14586438	5.94484e-01	0.8609150
11	2 - 1 - 2	0.13411700	0.212728197	0.109371711	0.81549476	1.33618e-01	0.3848350
12	2 - 1 - 3	0.00222005	0.010943645	0.059657552	26.87216584	4.94038e-09	0.0181953
13	2 - 2 - 1	0.17112200	0.108479844	0.099945294	0.58405871	6.27486e-02	0.1717250
14	2 - 2 - 2	0.71157300	0.782932362	0.123509395	0.17357235	6.47162e-01	0.8505570
15	2 - 2 - 3	0.11730500	0.108587788	0.065106838	0.55502185	6.06611e-02	0.1683660
16	2 - 3 - 1	0.00128653	0.009934338	0.063232920	49.14997689	4.56624e-09	0.0137074
17	2 - 3 - 2	0.18045600	0.177977398	0.047659223	0.26410440	1.03575e-01	0.2630300
18	2 - 3 - 3	0.81825700	0.812088279	0.071183395	0.08699393	7.22341e-01	0.8845160
19	3 - 1 - 1	0.86416500	0.789984782	0.089417063	0.10347221	6.78959e-01	0.8528630
20	3 - 1 - 2	0.13369200	0.203324935	0.084996189	0.63576122	1.38425e-01	0.3064110
21	3 - 1 - 3	0.00214275	0.006690284	0.006673217	3.11432345	4.73503e-09	0.0162010
22	3 - 2 - 1	0.15860200	0.105936432	0.069487827	0.43812705	6.87446e-02	0.1540580
23	3 - 2 - 2	0.72709400	0.792560758	0.083550500	0.11491018	7.28953e-01	0.8431910
24	3 - 2 - 3	0.11430400	0.101502809	0.022049093	0.19289870	6.98680e-02	0.1421320
25	3 - 3 - 1	0.00125011	0.007013564	0.029802662	23.84003170	4.64392e-09	0.0142972
26	3 - 3 - 2	0.17041300	0.178220283	0.031985615	0.18769469	1.25456e-01	0.2446250
27	3 - 3 - 3	0.82833700	0.814766174	0.043200160	0.05215288	7.44585e-01	0.8691880
28	4 - 1 - 1	0.85655900	0.798545619	0.111469486	0.13013638	6.10814e-01	0.9099060
29	4 - 1 - 2	0.14129500	0.191353849	0.091739531	0.64927655	8.20269e-02	0.3515530
30	4 - 1 - 3	0.00214524	0.010100530	0.055049139	25.66106321	4.09694e-09	0.0193268
31	4 - 2 - 1	0.13112900	0.117343067	0.083411133	0.63609982	5.32744e-02	0.3239980
32	4 - 2 - 2	0.76152200	0.771799836	0.105030313	0.13792157	4.41254e-01	0.8682230
33	4 - 2 - 3	0.10734900	0.110857101	0.064078220	0.59691492	5.82645e-02	0.2404400
34	4 - 3 - 1	0.00128911	0.008683241	0.049691552	38.54717738	4.36796e-09	0.0174050
35	4 - 3 - 2	0.16675300	0.182718815	0.064910856	0.38926350	8.63162e-02	0.3137450
36	4 - 3 - 3	0.83195800	0.808597930	0.078498508	0.09435393	6.74726e-01	0.9025770
37	5 - 1 - 1	0.84699300	0.801172101	0.098913075	0.11678146	7.05120e-01	0.8833600
38	5 - 1 - 2	0.15080700	0.185258189	0.059850962	0.39687125	1.07778e-01	0.2706990
39	5 - 1 - 3	0.00220055	0.013569714	0.082729332	37.59484305	4.67819e-09	0.0163002
40	5 - 2 - 1	0.11829400	0.110626458	0.068786856	0.58149066	6.11608e-02	0.2020070
41	5 - 2 - 2	0.77793600	0.784459334	0.087676219	0.11270364	6.65119e-01	0.8483640
42	5 - 2 - 3	0.10377000	0.104914197	0.063094379	0.60802138	6.28920e-02	0.1626170
43	5 - 3 - 1	0.00132245	0.012099451	0.072796909	55.04700276	4.56662e-09	0.0155527
44	5 - 3 - 2	0.16596100	0.180777427	0.048331375	0.29122128	1.03773e-01	0.2784970
45	5 - 3 - 3	0.83271600	0.807123132	0.083929521	0.10079009	6.85637e-01	0.8831920
46	6 - 1 - 1	0.83764700	0.798720634	0.098234731	0.11727462	6.66774e-01	0.8961440
47	6 - 1 - 2	0.16010800	0.190406560	0.071200744	0.44470448	9.89220e-02	0.3232800
48	6 - 1 - 3	0.00224500	0.010872808	0.063596535	28.32807789	4.39063e-09	0.0182242
49	6 - 2 - 1	0.11417900	0.107010705	0.061496637	0.53859849	4.69562e-02	0.1863690
50	6 - 2 - 2	0.78697900	0.793027497	0.074161816	0.09423608	6.71627e-01	0.8805430
51	6 - 2 - 3	0.09884210	0.099961788	0.040228580	0.40699844	4.75098e-02	0.1752140
52	6 - 3 - 1	0.00148724	0.007875555	0.035039113	23.55982421	4.72803e-09	0.0189102
53	6 - 3 - 2	0.17561000	0.205142408	0.109229299	0.62199931	1.12179e-01	0.4107480
54	6 - 3 - 3	0.82290300	0.786982040	0.116240798	0.14125699	5.37354e-01	0.8773400
55	7 - 1 - 1	0.84412400	0.810246282	0.096189560	0.11395193	7.15815e-01	0.9024530

```
56  7 - 1 - 2 0.15366200 0.177016425 0.054316027   0.35347729 9.18424e-02 0.2510090
57  7 - 1 - 3 0.00221412 0.012737301 0.077920872  35.19270498 4.33902e-09 0.0155883
58  7 - 2 - 1 0.10232000 0.112582779 0.067642331   0.66108612 6.01244e-02 0.1916540
59  7 - 2 - 2 0.79828200 0.785874471 0.073016053   0.09146649 6.67544e-01 0.8590180
60  7 - 2 - 3 0.09939880 0.101542739 0.037258402   0.37483754 5.85171e-02 0.1617790
61  7 - 3 - 1 0.00137382 0.011972895 0.068338622  49.74350508 5.22919e-09 0.0196825
62  7 - 3 - 2 0.16343300 0.191401580 0.061447796   0.37598157 1.17896e-01 0.3170890
63  7 - 3 - 3 0.83519400 0.796625528 0.092822902   0.11113933 6.67369e-01 0.8712580
64  8 - 1 - 1 0.85276700 0.812098861 0.105200785   0.12336404 6.96900e-01 0.9247220
65  8 - 1 - 2 0.14471100 0.172826598 0.062793680   0.43392472 6.58945e-02 0.2618950
66  8 - 1 - 3 0.00252204 0.015074533 0.089606814  35.52949749 4.32757e-09 0.0210501
67  8 - 2 - 1 0.08360080 0.114427019 0.074704152   0.89358178 5.41928e-02 0.2377110
68  8 - 2 - 2 0.82279200 0.763413501 0.116432699   0.14150927 5.08636e-01 0.8633120
69  8 - 2 - 3 0.09360690 0.122159470 0.085946775   0.91816709 5.28423e-02 0.3332530
70  8 - 3 - 1 0.00125494 0.009151083 0.052133233  41.54241060 4.57658e-09 0.0207354
71  8 - 3 - 2 0.14289200 0.192104718 0.112291658   0.78584986 8.89944e-02 0.3963780
72  8 - 3 - 3 0.85585300 0.798744173 0.124271775   0.14520224 5.60209e-01 0.9001030
73  9 - 1 - 1 0.86122700 0.809299156 0.121728390   0.14134298 6.84718e-01 0.9121350
74  9 - 1 - 2 0.13642200 0.171488458 0.073837262   0.54124160 6.62985e-02 0.2509280
75  9 - 1 - 3 0.00235114 0.019212366 0.106221395  45.17867711 5.21498e-09 0.0251074
76  9 - 2 - 1 0.09416540 0.108083009 0.037867347   0.40213653 4.77102e-02 0.1877900
77  9 - 2 - 2 0.81267500 0.740940635 0.127922821   0.15740957 4.43071e-01 0.8466620
78  9 - 2 - 3 0.09315930 0.150976341 0.120227658   1.29055991 6.53463e-02 0.4041620
79  9 - 3 - 1 0.00127144 0.008265459 0.044583748  35.06555377 3.61990e-09 0.0148463
80  9 - 3 - 2 0.14352600 0.179865799 0.112344675   0.78274790 7.00277e-02 0.4000700
81  9 - 3 - 3 0.85520200 0.811868734 0.124688221   0.14579973 5.37872e-01 0.9173550


Overall CV on movement
0.03275087



=====================================================================
GROWTH PARAMETER FITS
=====================================================================
  parameter observed  expected       RMSE         CV    LR2.5   UP97.5
1  mu_Alpha     5.47 5.4107687 0.08620933 0.01576039 5.296130 5.543920
2   mu_Beta     2.89 2.8723299 2.59851493 0.89914011 2.769170 3.004230
3     theta     1.00 0.9867233 4.48333256 4.48333256 0.923557 1.000000
4     omega     0.80 0.8014331 4.66857012 5.83571266 0.789595 0.811246
```

h. Design scenario: 60% examination of commercial catch; 60000 tags released

```
Mean number of tags released
  stratum     Tags     Cost
1       1 16152.37 480442.4
2       2 27675.45 716459.3
3       3 17576.26 527690.3
      tot     Tags    Cost
1 Total   61404.08 1724592

Mean number of fish examined
  stratum  Fishexam     Cost
1       1  907071.7 817359.5
2       2 1404949.3 514981.5
3       3 1010632.4 511627.0
       tot    exam    Cost
1 Total    3322653 1843968

Mean number of tags recovered
  stratum     Tags
1       1 466.1539
2       2 796.5644
3       3 544.7697
       tot     tags
1 Total    1807.488

=====================================================================
POPULATION FITS
=====================================================================

BY STRATUM & LENGTH

Total fits by length bin
```

Numbers

	stock	stratum	length_bin	true_pop	exp_pop	RMSE	CV	LR2.5	UP97.5	bias
1	1	1	1	16967870	8724453	10513257.8	0.6195980	121991.1	16045199	0.5141749
2	1	1	2	3301269	3106184	1231545.4	0.3730521	2178599.3	4253585	0.9409059
3	1	1	3	4652575	4331323	781777.6	0.1680312	3388928.3	5405922	0.9309518
4	1	1	4	1381480	1465343	827970.9	0.5993362	906583.3	2349004	1.0607052
5	1	1	5	2280736	2418811	1170283.4	0.5131166	1695547.9	3401956	1.0605398
6	1	1	6	1690434	1893122	1067091.5	0.6312530	1220809.5	2923127	1.1199030
7	1	1	7	2695764	2902600	1187051.5	0.4403395	2005294.4	4063523	1.0767263
8	1	1	8	1294287	1426843	676202.7	0.5224519	844196.0	2147174	1.1024164
9	1	1	9	1435985	1368277	379383.8	0.2641977	960920.4	1931365	0.9528492
10	2	2	1	29809355	15995866	14532243.8	0.4875061	1850003.5	24956643	0.5366056
11	2	2	2	5898813	6288947	1130409.5	0.1916334	4532935.4	8087471	1.0661378
12	2	2	3	7762039	8478145	1235013.0	0.1591093	6987274.6	10340085	1.0922574
13	2	2	4	2251332	2403509	498530.9	0.2214382	1608958.8	3336943	1.0675943
14	2	2	5	3837585	4116066	677493.3	0.1765416	3168082.9	5250315	1.0725666
15	2	2	6	3051663	3249217	622325.1	0.2039298	2352674.0	4344462	1.0647364
16	2	2	7	4201882	4534163	833566.0	0.1983792	3391044.3	5927683	1.0790790
17	2	2	8	2048807	2135022	455729.3	0.2224365	1428615.3	3098998	1.0420810
18	2	2	9	2229915	2044580	531117.1	0.2381782	1288495.0	3047439	0.9168869
19	3	3	1	18749189	12064793	12574051.9	0.6706451	484083.9	44077438	0.6434835
20	3	3	2	3765785	3692855	1058339.1	0.2810408	2810986.8	4911162	0.9806334
21	3	3	3	5044362	4841593	681265.5	0.1350548	4022964.4	5804779	0.9598029
22	3	3	4	1396332	1398336	553485.0	0.3963850	960023.2	2041085	1.0014352
23	3	3	5	2269169	2284310	600723.9	0.2647330	1674999.0	3026675	1.0066724
24	3	3	6	1616635	1708212	477737.0	0.2955132	1137670.0	2557301	1.0566469
25	3	3	7	2374611	2513842	1032493.2	0.4348051	1742062.0	3412212	1.0586330
26	3	3	8	1290950	1433379	836782.2	0.6481908	888261.6	2225754	1.1103282
27	3	3	9	1943119	1810356	1002423.5	0.5158836	1063112.5	2930146	0.9316749

biomass

	stock	stratum	length_bin	true_bio	exp_bio	RMSE_bio	CV_bio	LR2.5	UP97.5	bias
2	1	1	2	1250.8526	1178.7150	467.1288	0.3734483	826.7	1614.1	0.9423292
3	1	1	3	2292.1822	2121.6996	388.6434	0.1695517	1660.4	2648.7	0.9256243
4	1	1	4	824.0626	874.0868	493.8907	0.5993364	540.8	1401.2	1.0607043
5	1	1	5	1555.6796	1649.2912	797.9122	0.5129027	1156.0	2318.6	1.0601741
6	1	1	6	1367.3543	1533.4249	864.7027	0.6323911	988.7	2368.4	1.1214540
7	1	1	7	2839.7450	3062.4269	1252.4536	0.4410444	2115.2	4286.8	1.0784161
8	1	1	8	1964.1889	2154.8547	1019.4351	0.5190107	1274.4	3244.9	1.0970710
9	1	1	9	4313.6008	3606.0936	1213.1806	0.2812455	2534.8	5089.5	0.8359822
11	2	2	2	2236.2343	2388.4134	430.7202	0.1926096	1722.4	3071.6	1.0680515
12	2	2	3	3812.8285	4157.5295	601.8821	0.1578571	3427.3	5070.8	1.0904056
13	2	2	4	1342.9355	1433.7100	297.3773	0.2214382	959.8	1990.5	1.0675941
14	2	2	5	2620.1145	2806.4728	460.4844	0.1757497	2159.8	3579.7	1.0711260
15	2	2	6	2471.0890	2630.7347	503.7577	0.2038606	1903.9	3517.0	1.0646054
16	2	2	7	4395.4781	4753.2303	877.7001	0.1996825	3557.7	6210.4	1.0813910
17	2	2	8	3086.9274	3229.7451	691.9371	0.2241507	2160.2	4689.6	1.0462653
18	2	2	9	7115.6112	5456.5295	2128.3668	0.2991123	3406.6	8183.6	0.7668392
20	3	3	2	1426.8460	1400.7543	401.2607	0.2812222	1066.5	1863.5	0.9817137
21	3	3	3	2477.8967	2370.8302	336.1740	0.1356691	1969.5	2842.8	0.9567914
22	3	3	4	832.9220	834.1181	330.1575	0.3963847	572.7	1217.5	1.0014361
23	3	3	5	1547.2618	1556.9653	409.5060	0.2646650	1142.0	2063.2	1.0062714
24	3	3	6	1307.5613	1383.1079	387.0806	0.2960325	921.3	2070.9	1.0577767
25	3	3	7	2496.4956	2638.1497	1082.2016	0.4334883	1828.2	3581.3	1.0567412
26	3	3	8	1957.3738	2160.6178	1258.5050	0.6429559	1339.0	3355.9	1.1038350
27	3	3	9	6542.3856	4899.9820	3144.7799	0.4806779	2899.8	7816.1	0.7489595

BY STOCK & LENGTH

Total fits by length bin

numbers

	stock	length_bin	true_pop	exp_pop	RMSE	CV	bias
1	1	1	16967870	8724453	10513257.8	0.6195980	0.5141749
4	1	2	3301269	3106184	1231545.4	0.3730521	0.9409059
7	1	3	4652575	4331323	781777.6	0.1680312	0.9309518
10	1	4	1381480	1465343	827970.9	0.5993362	1.0607052
13	1	5	2280736	2418811	1170283.4	0.5131166	1.0605398
16	1	6	1690434	1893122	1067091.5	0.6312530	1.1199030
19	1	7	2695764	2902600	1187051.5	0.4403395	1.0767263
22	1	8	1294287	1426843	676202.7	0.5224519	1.1024164
25	1	9	1435985	1368277	379383.8	0.2641977	0.9528492
2	2	1	29809355	15995866	14532243.8	0.4875061	0.5366056
5	2	2	5898813	6288947	1130409.5	0.1916334	1.0661378
8	2	3	7762039	8478145	1235013.0	0.1591093	1.0922574

```
11     2          4  2251332  2403509   498530.9 0.2214382 1.0675943
14     2          5  3837585  4116066   677493.3 0.1765416 1.0725666
17     2          6  3051663  3249217   622325.1 0.2039298 1.0647364
20     2          7  4201882  4534163   833566.0 0.1983792 1.0790790
23     2          8  2048807  2135022   455729.3 0.2224365 1.0420810
26     2          9  2229915  2044580   531117.1 0.2381782 0.9168869
3      3          1 18749189 12064793 12574051.9 0.6706451 0.6434835
6      3          2  3765785  3692855  1058339.1 0.2810408 0.9806334
9      3          3  5044362  4841593   681265.5 0.1350548 0.9598029
12     3          4  1396332  1398336   553485.0 0.3963850 1.0014352
15     3          5  2269169  2284310   600723.9 0.2647330 1.0066724
18     3          6  1616635  1708212   477737.0 0.2955132 1.0566469
21     3          7  2374611  2513842  1032493.2 0.4348051 1.0586330
24     3          8  1290950  1433379   836782.2 0.6481908 1.1103282
27     3          9  1943119  1810356  1002423.5 0.5158836 0.9316749


   biomass
   stock length_bin  true_bio   exp_bio      RMSE        CV      bias
1      1          2 1250.8526 1178.7150  467.1288 0.3734483 0.9423292
4      1          3 2292.1822 2121.6996  388.6434 0.1695517 0.9256243
7      1          4  824.0626  874.0868  493.8907 0.5993364 1.0607043
10     1          5 1555.6796 1649.2912  797.9122 0.5129027 1.0601741
13     1          6 1367.3543 1533.4249  864.7027 0.6323911 1.1214540
16     1          7 2839.7450 3062.4269 1252.4536 0.4410444 1.0784161
19     1          8 1964.1889 2154.8547 1019.4351 0.5190107 1.0970710
22     1          9 4313.6008 3606.0936 1213.1806 0.2812455 0.8359822
2      2          2 2236.2343 2388.4134  430.7202 0.1926096 1.0680515
5      2          3 3812.8285 4157.5295  601.8821 0.1578571 1.0904056
8      2          4 1342.9355 1433.7100  297.3773 0.2214382 1.0675941
11     2          5 2620.1145 2806.4728  460.4844 0.1757497 1.0711260
14     2          6 2471.0890 2630.7347  503.7577 0.2038606 1.0646054
17     2          7 4395.4781 4753.2303  877.7001 0.1996825 1.0813910
20     2          8 3086.9274 3229.7451  691.9371 0.2241507 1.0462653
23     2          9 7115.6112 5456.5295 2128.3668 0.2991123 0.7668392
3      3          2 1426.8460 1400.7543  401.2607 0.2812222 0.9817137
6      3          3 2477.8967 2370.8302  336.1740 0.1356691 0.9567914
9      3          4  832.9220  834.1181  330.1575 0.3963847 1.0014361
12     3          5 1547.2618 1556.9653  409.5060 0.2646650 1.0062714
15     3          6 1307.5613 1383.1079  387.0806 0.2960325 1.0577767
18     3          7 2496.4956 2638.1497 1082.2016 0.4334883 1.0567412
21     3          8 1957.3738 2160.6178 1258.5050 0.6429559 1.1038350
24     3          9 6542.3856 4899.9820 3144.7799 0.4806779 0.7489595
```

```
STRATUM FITS +25cm
   numbers
  stratum true_pop  exp_pop    RMSE         CV      bias
1       1 18732530 18912503 2707755 0.14454828 1.0096075
2       2 31282036 33249649 2254442 0.07206826 1.0628991
3       3 19700964 19682882 2291452 0.11631166 0.9990822

   biomass
  stratum true_bio  exp_bio     RMSE         CV      bias
1       1 16407.67 16180.59 2465.208 0.15024734 0.9861605
2       2 27081.22 26856.37 2623.188 0.09686372 0.9916971
3       3 18588.74 17244.53 3653.107 0.19652253 0.9276865
```

```
STOCK FITS +25cm
   numbers
  stock true_pop  exp_pop    RMSE         CV      bias
1     1 18732530 18912503 2707755 0.14454828 1.0096075
2     2 31282036 33249649 2254442 0.07206826 1.0628991
3     3 19700964 19682882 2291452 0.11631166 0.9990822

   biomass
  stock true_bio  exp_bio     RMSE         CV      bias
1     1 16407.67 16180.59 2465.208 0.15024734 0.9861605
```

```
2     2 27081.22 26856.37 2623.188 0.09686372 0.9916971
3     3 18588.74 17244.53 3653.107 0.19652253 0.9276865
```

```
SNA 1 FITS (25 cm +)
   numbers
  true_pop  exp_pop    RMSE         CV     bias
1 69715530 71845034 4202999 0.06028784 1.030546

   biomass
  true_bio  exp_bio     RMSE         CV      bias
1 62077.63 60281.48 5128.699 0.08261751 0.9710662
```

```
================================================================
TAG RECOVERY FITS
================================================================
  release recovery      TagObs     TagExp      RMSE          CV
1       1        1 396.2423581 393.348316 10.928864 0.027581261
2       1        2 104.0556769  82.353181 22.894062 0.220017426
3       1        3   0.7543668   3.016929  4.831200 6.404311715
4       2        1  68.8253275  91.563832 24.066687 0.349677773
5       2        2 606.9694323 606.527116  3.550611 0.005849737
6       2        3  93.8144105  94.209718  7.532722 0.080293872
7       3        1   1.0862445   2.996121  4.734891 4.358954803
8       3        2  85.5393013  86.220685  7.608307 0.088945159
9       3        3 450.2008734 447.172500  9.868940 0.021921193


   rec_stra Length_bin    TagObs    TagExp     RMSE         CV
1         1          1  22.89738  24.32433 3.345340 0.14610143
2         1          2  72.08297  75.46322 5.908986 0.08197478
3         1          3 121.90721 128.33082 8.577570 0.07036147
4         1          4  30.08079  31.51025 3.232414 0.10745777
5         1          5  51.48690  53.66959 4.297610 0.08346996
6         1          6  33.60699  35.02680 3.254825 0.09684964
7         1          7  53.30568  55.67796 4.882533 0.09159499
8         1          8  32.52838  33.93248 3.224116 0.09911700
9         1          9  48.25764  49.97282 3.374974 0.06993658
10        2          1  43.55022  41.73742 4.087337 0.09385343
11        2          2 102.28930  98.97496 6.593740 0.06446168
12        2          3 198.04258 191.76350 9.970480 0.05034513
13        2          4  60.47380  58.71050 4.037553 0.06676532
14        2          5 100.65066  98.51057 5.259549 0.05225548
15        2          6  70.62882  69.53406 4.207383 0.05957033
16        2          7 104.23472 102.69222 5.386056 0.05167238
17        2          8  55.76856  54.42228 3.795921 0.06806561
18        2          9  60.92576  58.75547 4.676433 0.07675624
19        3          1  21.63865  22.01131 3.143431 0.14526928
20        3          2  82.89520  82.82620 4.105325 0.04952428
21        3          3 155.29913 155.15282 4.649559 0.02993937
22        3          4  37.40721  37.73495 2.732494 0.07304725
23        3          5  65.51856  65.47264 3.669170 0.05600200
24        3          6  44.95633  44.62573 3.168945 0.07048940
25        3          7  70.25983  69.41869 4.514374 0.06425256
26        3          8  33.53057  33.44954 2.889867 0.08618606
27        3          9  33.26419  33.70725 3.186034 0.09577970

    TagObs   TagExp     RMSE         CV
1 1807.488 1807.408 24.68954 0.01365959
```

```
================================================================
PROPORTIONAL MOVEMENT FITS
================================================================
   Lb__Fr__To    true_mm     geo_obs        RMSE          CV       LR2.5    UP97.5
1   1 - 1 - 1 0.85874900 0.753293343 0.212860617  0.24787291 1.03004e-02 0.9095370
2   1 - 1 - 2 0.13905100 0.203136510 0.111158443  0.79940772 2.64540e-02 0.3713610
3   1 - 1 - 3 0.00219992 0.043570131 0.183182530 83.26781407 2.92018e-09 0.8358230
4   1 - 2 - 1 0.15032400 0.108291165 0.101872760  0.67768793 1.90076e-03 0.2155720
```

5	1 - 2 - 2	0.73855600	0.754225193	0.150265070	0.20345792	9.39761e-02	0.8692630
6	1 - 2 - 3	0.11112000	0.137483637	0.139424538	1.25472046	1.44852e-02	0.7028590
7	1 - 3 - 1	0.00132185	0.017868013	0.109238646	82.64072772	2.47169e-09	0.0833723
8	1 - 3 - 2	0.17721900	0.181862317	0.090116009	0.50850083	2.02211e-02	0.3234870
9	1 - 3 - 3	0.82145900	0.800269666	0.139475712	0.16979023	3.99748e-02	0.9283600
10	2 - 1 - 1	0.86366300	0.775708889	0.110616649	0.12807849	6.45094e-01	0.8426430
11	2 - 1 - 2	0.13411700	0.216740158	0.098225598	0.73238737	1.49676e-01	0.3410340
12	2 - 1 - 3	0.00222005	0.007550951	0.054956275	24.75452148	2.94597e-09	0.0141593
13	2 - 2 - 1	0.17112200	0.107487676	0.087976097	0.51411331	7.34615e-02	0.1480250
14	2 - 2 - 2	0.71157300	0.785654295	0.109799897	0.15430588	7.12654e-01	0.8350870
15	2 - 2 - 3	0.11730500	0.106858047	0.058111431	0.49538750	7.24074e-02	0.1468890
16	2 - 3 - 1	0.00128653	0.006705039	0.052056908	40.46303493	2.57604e-09	0.0122379
17	2 - 3 - 2	0.18045600	0.177557897	0.030057387	0.16656352	1.22730e-01	0.2345880
18	2 - 3 - 3	0.81825700	0.815737094	0.053876538	0.06584305	7.56661e-01	0.8701390
19	3 - 1 - 1	0.86416500	0.789681074	0.082815958	0.09583350	7.10572e-01	0.8386110
20	3 - 1 - 2	0.13369200	0.206002335	0.080857559	0.60480477	1.56269e-01	0.2831320
21	3 - 1 - 3	0.00214275	0.004316612	0.004953957	2.31196228	2.91221e-09	0.0139951
22	3 - 2 - 1	0.15860200	0.105611863	0.063075889	0.39769920	8.04902e-02	0.1365290
23	3 - 2 - 2	0.72709400	0.791595239	0.084654742	0.11642888	7.49525e-01	0.8282000
24	3 - 2 - 3	0.11430400	0.102792923	0.035493658	0.31051982	7.81174e-02	0.1293600
25	3 - 3 - 1	0.00125011	0.003857458	0.004789467	3.83123665	2.62421e-09	0.0121011
26	3 - 3 - 2	0.17041300	0.177401793	0.022294495	0.13082626	1.40518e-01	0.2132260
27	3 - 3 - 3	0.82833700	0.818740755	0.023205744	0.02801486	7.81223e-01	0.8543310
28	4 - 1 - 1	0.85655900	0.807287716	0.078070807	0.09114469	6.92171e-01	0.8936660
29	4 - 1 - 2	0.14129500	0.187577191	0.070536521	0.49921455	9.73347e-02	0.2951120
30	4 - 1 - 3	0.00214524	0.005135072	0.031917372	14.87822883	2.78636e-09	0.0143565
31	4 - 2 - 1	0.13112900	0.115048047	0.087257246	0.66543058	7.08946e-02	0.1880910
32	4 - 2 - 2	0.76152200	0.779492246	0.087843020	0.11535191	6.67725e-01	0.8437120
33	4 - 2 - 3	0.10734900	0.105459690	0.038094871	0.35486936	6.36420e-02	0.1725230
34	4 - 3 - 1	0.00128911	0.012280147	0.088712634	68.81696177	2.60517e-09	0.0160271
35	4 - 3 - 2	0.16675300	0.180536707	0.044097163	0.26444600	1.12496e-01	0.2579570
36	4 - 3 - 3	0.83195800	0.807183130	0.086827660	0.10436544	7.28391e-01	0.8760770
37	5 - 1 - 1	0.84699300	0.809098394	0.063022122	0.07440690	7.40335e-01	0.8720420
38	5 - 1 - 2	0.15080700	0.185077648	0.048740404	0.32319722	1.18828e-01	0.2525130
39	5 - 1 - 3	0.00220055	0.005823970	0.041276687	18.75744109	2.73126e-09	0.0136035
40	5 - 2 - 1	0.11829400	0.109324713	0.066759383	0.56435139	7.28140e-02	0.1535690
41	5 - 2 - 2	0.77793600	0.788632829	0.075134655	0.09658205	7.34010e-01	0.8396720
42	5 - 2 - 3	0.10377000	0.102042459	0.041001941	0.39512326	6.83060e-02	0.1391340
43	5 - 3 - 1	0.00132245	0.011335080	0.079513803	60.12613169	2.63163e-09	0.0185521
44	5 - 3 - 2	0.16596100	0.182142958	0.034459060	0.20763348	1.30027e-01	0.2507000
45	5 - 3 - 3	0.83271600	0.806521974	0.082282170	0.09881180	7.39499e-01	0.8570400
46	6 - 1 - 1	0.83764700	0.809174154	0.055789327	0.06660243	7.16082e-01	0.8803080
47	6 - 1 - 2	0.16010800	0.186033986	0.048008296	0.29984945	1.14242e-01	0.2752340
48	6 - 1 - 3	0.00224500	0.004791851	0.026492409	11.80062747	2.73577e-09	0.0141063
49	6 - 2 - 1	0.11417900	0.109275294	0.077557159	0.67925940	6.57037e-02	0.1665260
50	6 - 2 - 2	0.78697900	0.790111955	0.086198470	0.10953084	7.09710e-01	0.8485290
51	6 - 2 - 3	0.09884210	0.100612755	0.047324843	0.47879236	6.11733e-02	0.1558450
52	6 - 3 - 1	0.00148724	0.013061664	0.089976416	60.49892116	2.82705e-09	0.0198313
53	6 - 3 - 2	0.17561000	0.188970449	0.045870284	0.26120542	1.32972e-01	0.2813260
54	6 - 3 - 3	0.82290300	0.797967895	0.091644729	0.11136760	6.73022e-01	0.8577310
55	7 - 1 - 1	0.84412400	0.816933930	0.085597067	0.10140343	7.64797e-01	0.8906080
56	7 - 1 - 2	0.15366200	0.172053384	0.038546980	0.25085564	1.03681e-01	0.2261820
57	7 - 1 - 3	0.00221412	0.011012691	0.080659817	36.42974044	2.52332e-09	0.0131135
58	7 - 2 - 1	0.10232000	0.111768980	0.068549847	0.66995551	7.38637e-02	0.1632180
59	7 - 2 - 2	0.79828200	0.783111842	0.089827657	0.11252622	7.12508e-01	0.8374140
60	7 - 2 - 3	0.09939880	0.105119184	0.062811754	0.63191662	6.93909e-02	0.1488520
61	7 - 3 - 1	0.00137382	0.009811035	0.070594868	51.38582045	2.86397e-09	0.0147378
62	7 - 3 - 2	0.16343300	0.186860984	0.044200966	0.27045313	1.34937e-01	0.2795030
63	7 - 3 - 3	0.83519400	0.803327972	0.079378431	0.09504191	7.06880e-01	0.8577230
64	8 - 1 - 1	0.85276700	0.815609113	0.115845977	0.13584716	7.11971e-01	0.9085790
65	8 - 1 - 2	0.14471100	0.166201038	0.046904980	0.32412864	8.32486e-02	0.2290670
66	8 - 1 - 3	0.00252204	0.018189856	0.113698978	45.08214686	2.62331e-09	0.0189680
67	8 - 2 - 1	0.08360080	0.111040738	0.071521612	0.85551348	5.95225e-02	0.1773580
68	8 - 2 - 2	0.82279200	0.767883026	0.105722702	0.12849262	6.28146e-01	0.8359160
69	8 - 2 - 3	0.09360690	0.121076231	0.082128379	0.87737526	7.07480e-02	0.2297340
70	8 - 3 - 1	0.00125494	0.009511236	0.069957453	55.74565552	2.60720e-09	0.0157310
71	8 - 3 - 2	0.14289200	0.178242294	0.053006727	0.37095658	1.00045e-01	0.2629040
72	8 - 3 - 3	0.85585300	0.812246455	0.085798415	0.10024901	7.14033e-01	0.8890170
73	9 - 1 - 1	0.86122700	0.824637269	0.107077595	0.12433144	7.52317e-01	0.9135370
74	9 - 1 - 2	0.13642200	0.159020037	0.048549705	0.35587886	7.42805e-02	0.2251960
75	9 - 1 - 3	0.00235114	0.016342673	0.106087542	45.12174608	2.88067e-09	0.0215014
76	9 - 2 - 1	0.09416540	0.106336463	0.040205022	0.42696173	6.54783e-02	0.1693280
77	9 - 2 - 2	0.81267500	0.737186542	0.121777692	0.14984796	5.69665e-01	0.8235350
78	9 - 2 - 3	0.09315930	0.156476977	0.114182510	1.22566947	8.68835e-02	0.3081810
79	9 - 3 - 1	0.00127144	0.004623264	0.031288753	24.60891014	2.17324e-09	0.0117364
80	9 - 3 - 2	0.14352600	0.174862083	0.073449574	0.51175100	8.92587e-02	0.2567820
81	9 - 3 - 3	0.85520200	0.820514663	0.080689253	0.09435110	7.37557e-01	0.9056110

```
Overall CV on movement
0.02783233


================================================================
GROWTH PARAMETER FITS
================================================================
  parameter observed  expected       RMSE         CV    LR2.5   UP97.5
1  mu_Alpha     5.47 5.4078348 0.07613935 0.01391944 5.326770 5.489800
2   mu_Beta     2.89 2.8628941 2.60758078 0.90227709 2.784550 2.948460
3     theta     1.00 0.9923562 4.47766740 4.47766740 0.946970 1.000000
4     omega     0.80 0.8018164 4.66818532 5.83523165 0.794144 0.809438
```

i. Design scenario: 90% examination of commercial catch; 60000 tags released

```
Mean number of tags released
  stratum     Tags     Cost
1       1 16153.34 240603.9
2       2 27691.10 359261.0
3       3 17586.74 264927.9
      tot     Tags     Cost
1 Total   61431.18 864792.7

Mean number of fish examined
  stratum Fishexam      Cost
1       1  1319196 1212934.5
2       2  2031548  745585.5
3       3  1453288  746463.5
       tot    exam    Cost
1 Total    4804032 2704984

Mean number of tags recovered
  stratum      Tags
1       1  678.8972
2       2 1153.2853
3       3  785.0312
       tot     tags
1 Total    2617.214

====================================================================
POPULATION FITS
====================================================================

BY STRATUM & LENGTH

Total fits by length bin

   Numbers


   stock stratum length_bin true_pop  exp_pop       RMSE        CV     LR2.5   UP97.5      bias
1      1       1          1 16967870  9008047 11200950.3 0.6601271  160211.5 17368070 0.5308885
2      1       1          2  3301269  3134216  1510757.4 0.4576293 2263154.3  3977315 0.9493973
3      1       1          3  4652575  4430823  1337346.0 0.2874421 3515400.8  5383967 0.9523377
4      1       1          4  1381480  1390214   333482.8 0.2413953  987086.7  1971098 1.0063222
5      1       1          5  2280736  2354764   758129.5 0.3324056 1735377.8  3081393 1.0324581
6      1       1          6  1690434  1779750   322392.4 0.1907158 1276103.8  2443512 1.0528361
7      1       1          7  2695764  2837590   856840.5 0.3178470 2152355.8  3660499 1.0526106
8      1       1          8  1294287  1382775   372673.5 0.2879373  986728.7  1926322 1.0683681
9      1       1          9  1435985  1357469   221734.4 0.1544128 1028902.0  1789096 0.9453226
10     2       2          1 29809355 15990775 14405101.2 0.4832410 2022113.4 23620634 0.5364348
11     2       2          2  5898813  6285609  1096358.1 0.1858608 4872869.0  7937347 1.0655719
12     2       2          3  7762039  8375985  1319090.0 0.1699412 7001384.6  9819722 1.0790960
13     2       2          4  2251332  2429860   410188.7 0.1821982 1867630.9  3088442 1.0792988
14     2       2          5  3837585  4128725   602054.6 0.1568837 3379473.0  5003806 1.0758653
15     2       2          6  3051663  3273352   466702.7 0.1529339 2600492.2  4144189 1.0726453
16     2       2          7  4201882  4563751   676327.2 0.1609582 3727778.7  5631860 1.0861206
17     2       2          8  2048807  2150515   387173.3 0.1889750 1618453.1  2896111 1.0496429
18     2       2          9  2229915  2029110   467000.4 0.2094252 1403255.1  2904355 0.9099495
19     3       3          1 18749189 10839103 11025915.5 0.5880743  439168.1 30116085 0.5781105
20     3       3          2  3765785  3649647   896864.9 0.2381615 2873417.4  4596429 0.9691597
21     3       3          3  5044362  4828414   710926.2 0.1409348 4120675.0  5724766 0.9571902
22     3       3          4  1396332  1392877   329962.3 0.2363065 1008331.3  1913845 0.9975258
23     3       3          5  2269169  2289639   708116.8 0.3120600 1801320.8  2862336 1.0090210
```

24	3	3	6	1616635	1684424	341880.6	0.2114767	1251671.1	2356731	1.0419320
25	3	3	7	2374611	2454304	705953.0	0.2972920	1877766.7	3069072	1.0335605
26	3	3	8	1290950	1363508	555899.6	0.4306127	943218.5	1914767	1.0562045
27	3	3	9	1943119	1730295	628578.5	0.3234894	1157158.3	2549226	0.8904726

biomass

	stock	stratum	length_bin	true_bio	exp_bio	RMSE_bio	CV_bio	LR2.5	UP97.5	bias
2	1	1	2	1250.8526	1189.3154	572.8945	0.4580032	858.7	1509.0	0.9508038
3	1	1	3	2292.1822	2170.5120	657.4197	0.2868095	1722.2	2636.6	0.9469195
4	1	1	4	824.0626	829.2732	198.9241	0.2413944	588.8	1175.8	1.0063230
5	1	1	5	1555.6796	1605.6552	516.9658	0.3323087	1182.9	2101.3	1.0321246
6	1	1	6	1367.3543	1441.6214	261.6822	0.1913785	1033.6	1978.8	1.0543145
7	1	1	7	2839.7450	2994.3369	905.0083	0.3186935	2272.0	3861.8	1.0544387
8	1	1	8	1964.1889	2088.2527	560.8593	0.2855424	1489.1	2910.8	1.0631629
9	1	1	9	4313.6008	3577.5141	917.0352	0.2125916	2723.9	4721.0	0.8293568
11	2	2	2	2236.2343	2387.2708	417.8865	0.1868706	1850.9	3015.7	1.0675405
12	2	2	3	3812.8285	4107.5600	644.0238	0.1689097	3430.7	4816.7	1.0772999
13	2	2	4	1342.9355	1449.4280	244.6809	0.1821985	1114.1	1842.3	1.0792983
14	2	2	5	2620.1145	2815.1082	408.8153	0.1560296	2304.6	3412.0	1.0744218
15	2	2	6	2471.0890	2650.2936	377.7337	0.1528612	2105.2	3354.8	1.0725205
16	2	2	7	4395.4781	4784.0181	713.8470	0.1624049	3909.6	5908.1	1.0883954
17	2	2	8	3086.9274	3253.4262	589.1162	0.1908423	2444.4	4379.1	1.0539367
18	2	2	9	7115.6112	5413.2998	2041.2806	0.2868735	3751.1	7723.0	0.7607639
20	3	3	2	1426.8460	1384.3680	340.0648	0.2383332	1090.2	1743.5	0.9702295
21	3	3	3	2477.8967	2364.2653	350.6376	0.1415061	2016.6	2802.8	0.9541420
22	3	3	4	832.9220	830.8620	196.8245	0.2363061	601.5	1141.6	0.9975268
23	3	3	5	1547.2618	1560.5925	482.6324	0.3119268	1227.6	1950.9	1.0086157
24	3	3	6	1307.5613	1363.8653	277.0818	0.2119073	1013.1	1909.0	1.0430603
25	3	3	7	2496.4956	2575.7460	740.5403	0.2966319	1971.4	3218.2	1.0317446
26	3	3	8	1957.3738	2055.3990	836.9463	0.4275863	1423.5	2884.7	1.0500799
27	3	3	9	6542.3856	4686.6808	2453.5597	0.3750252	3108.0	6909.8	0.7163566

BY STOCK & LENGTH

Total fits by length bin

numbers

	stock	length_bin	true_pop	exp_pop	RMSE	CV	bias
1	1	1	16967870	9008047	11200950.3	0.6601271	0.5308885
4	1	2	3301269	3134216	1510757.4	0.4576293	0.9493973
7	1	3	4652575	4430823	1337346.0	0.2874421	0.9523377
10	1	4	1381480	1390214	333482.8	0.2413953	1.0063222
13	1	5	2280736	2354764	758129.5	0.3324056	1.0324581
16	1	6	1690434	1779750	322392.4	0.1907158	1.0528361
19	1	7	2695764	2837590	856840.5	0.3178470	1.0526106
22	1	8	1294287	1382775	372673.5	0.2879373	1.0683681
25	1	9	1435985	1357469	221734.4	0.1544128	0.9453226
2	2	1	29809355	15990775	14405101.2	0.4832410	0.5364348
5	2	2	5898813	6285609	1096358.1	0.1858608	1.0655719
8	2	3	7762039	8375985	1319090.0	0.1699412	1.0790960
11	2	4	2251332	2429860	410188.7	0.1821982	1.0792988
14	2	5	3837585	4128725	602054.6	0.1568837	1.0758653
17	2	6	3051663	3273352	466702.7	0.1529339	1.0726453
20	2	7	4201882	4563751	676327.2	0.1609582	1.0861206
23	2	8	2048807	2150515	387173.3	0.1889750	1.0496429
26	2	9	2229915	2029110	467000.4	0.2094252	0.9099495
3	3	1	18749189	10839103	11025915.5	0.5880743	0.5781105
6	3	2	3765785	3649647	896864.9	0.2381615	0.9691597
9	3	3	5044362	4828414	710926.2	0.1409348	0.9571902
12	3	4	1396332	1392877	329962.3	0.2363065	0.9975258
15	3	5	2269169	2289639	708116.8	0.3120600	1.0090210
18	3	6	1616635	1684424	341880.6	0.2114767	1.0419320
21	3	7	2374611	2454304	705953.0	0.2972920	1.0335605
24	3	8	1290950	1363508	555899.6	0.4306127	1.0562045
27	3	9	1943119	1730295	628578.5	0.3234894	0.8904726

biomass

	stock	length_bin	true_bio	exp_bio	RMSE	CV	bias
1	1	2	1250.8526	1189.3154	572.8945	0.4580032	0.9508038
4	1	3	2292.1822	2170.5120	657.4197	0.2868095	0.9469195
7	1	4	824.0626	829.2732	198.9241	0.2413944	1.0063230
10	1	5	1555.6796	1605.6552	516.9658	0.3323087	1.0321246
13	1	6	1367.3543	1441.6214	261.6822	0.1913785	1.0543145
16	1	7	2839.7450	2994.3369	905.0083	0.3186935	1.0544387

```
19     1          8 1964.1889 2088.2527  560.8593 0.2855424 1.0631629
22     1          9 4313.6008 3577.5141  917.0352 0.2125916 0.8293568
2      2          2 2236.2343 2387.2708  417.8865 0.1868706 1.0675405
5      2          3 3812.8285 4107.5600  644.0238 0.1689097 1.0772999
8      2          4 1342.9355 1449.4280  244.6809 0.1821985 1.0792983
11     2          5 2620.1145 2815.1082  408.8153 0.1560296 1.0744218
14     2          6 2471.0890 2650.2936  377.7337 0.1528612 1.0725205
17     2          7 4395.4781 4784.0181  713.8470 0.1624049 1.0883954
20     2          8 3086.9274 3253.4262  589.1162 0.1908423 1.0539367
23     2          9 7115.6112 5413.2998 2041.2806 0.2868735 0.7607639
3      3          2 1426.8460 1384.3680  340.0648 0.2383332 0.9702295
6      3          3 2477.8967 2364.2653  350.6376 0.1415061 0.9541420
9      3          4  832.9220  830.8620  196.8245 0.2363061 0.9975268
12     3          5 1547.2618 1560.5925  482.6324 0.3119268 1.0086157
15     3          6 1307.5613 1363.8653  277.0818 0.2119073 1.0430603
18     3          7 2496.4956 2575.7460  740.5403 0.2966319 1.0317446
21     3          8 1957.3738 2055.3990  836.9463 0.4275863 1.0500799
24     3          9 6542.3856 4686.6808 2453.5597 0.3750252 0.7163566
```

```
STRATUM FITS +25cm
   numbers
  stratum true_pop  exp_pop    RMSE         CV      bias
1       1 18732530 18667601 2404791 0.12837511 0.9965339
2       2 31282036 33236907 2125076 0.06793278 1.0624918
3       3 19700964 19393108 1799854 0.09135868 0.9843735

   biomass
  stratum true_bio  exp_bio     RMSE         CV      bias
1       1 16407.67 15896.48 1763.595 0.10748604 0.9688447
2       2 27081.22 26860.40 2445.923 0.09031805 0.9918462
3       3 18588.74 16821.78 2802.833 0.15078121 0.9049444
```

```
STOCK FITS +25cm
   numbers
  stock true_pop  exp_pop    RMSE         CV      bias
1     1 18732530 18667601 2404791 0.12837511 0.9965339
2     2 31282036 33236907 2125076 0.06793278 1.0624918
3     3 19700964 19393108 1799854 0.09135868 0.9843735

   biomass
  stock true_bio  exp_bio     RMSE         CV      bias
1     1 16407.67 15896.48 1763.595 0.10748604 0.9688447
2     2 27081.22 26860.40 2445.923 0.09031805 0.9918462
3     3 18588.74 16821.78 2802.833 0.15078121 0.9049444
```

```
SNA 1 FITS (25 cm +)
   numbers
  true_pop  exp_pop    RMSE         CV     bias
1 69715530 71297616 3679462 0.05277822 1.022693

   biomass
  true_bio  exp_bio     RMSE         CV      bias
1 62077.63 59578.66 4116.877 0.06631822 0.9597446
```

```
================================================================
TAG RECOVERY FITS
================================================================
  release recovery     TagObs     TagExp      RMSE          CV
1       1        1 577.186492 574.346820 19.047516 0.033000627
2       1        2 149.864919 118.979599 32.346376 0.215836874
3       1        3   1.014113   2.791926  5.305916 5.232076372
```

```
4       2        1 100.103831 132.656847 34.100744 0.340653735
5       2        2 879.470766 878.699936  5.411592 0.006153237
6       2        3 134.990927 135.636365 10.299997 0.076301404
7       3        1   1.606855   2.778705  5.161732 3.212319984
8       3        2 123.949597 125.164312  9.629765 0.077690973
9       3        3 649.026210 646.108457 14.143069 0.021791213
```

	rec_stra	Length_bin	TagObs	TagExp	RMSE	CV
1	1	1	33.30343	35.22530	4.242180	0.12737969
2	1	2	104.60282	109.32080	8.509684	0.08135234
3	1	3	177.33669	185.69716	12.208233	0.06884212
4	1	4	43.48085	45.83349	4.011495	0.09225891
5	1	5	74.75302	78.03818	5.475710	0.07325068
6	1	6	49.02016	51.15053	3.871880	0.07898546
7	1	7	77.69254	81.10212	6.125816	0.07884690
8	1	8	47.85585	49.90495	3.951182	0.08256424
9	1	9	70.85181	73.50985	4.352163	0.06142627
10	2	1	62.68044	60.05684	5.266399	0.08401981
11	2	2	147.19556	142.70572	8.498842	0.05773844
12	2	3	287.31855	279.12305	14.090482	0.04904132
13	2	4	86.57157	84.18317	5.195880	0.06001832
14	2	5	145.53125	142.35445	6.777236	0.04656894
15	2	6	102.56552	100.83109	5.163776	0.05034612
16	2	7	151.24093	148.79446	6.663088	0.04405611
17	2	8	81.11492	78.80890	4.947245	0.06099057
18	2	9	89.06653	85.98616	6.186198	0.06945592
19	3	1	31.53931	32.22745	4.677056	0.14829288
20	3	2	120.09173	119.85839	5.749291	0.04787416
21	3	3	223.75907	223.59098	6.026200	0.02693164
22	3	4	54.09073	54.11941	3.086260	0.05705710
23	3	5	93.97278	93.86072	4.499924	0.04788540
24	3	6	64.63710	64.23877	3.327047	0.05147272
25	3	7	100.87298	99.90670	4.740492	0.04699467
26	3	8	47.88609	48.13867	3.215885	0.06715697
27	3	9	48.18145	48.59566	3.959211	0.08217292

	TagObs	TagExp	RMSE	CV
1	2617.214	2617.163	32.5333	0.01243051

```
======================================================================
PROPORTIONAL MOVEMENT FITS
======================================================================
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	Lb__Fr__To	true_mm	geo_obs	RMSE	CV	LR2.5	UP97.5
1	1 - 1 - 1	0.85874900	0.769441008	0.177792361	0.20703647	1.27120e-02	0.87957600
2	1 - 1 - 2	0.13905100	0.201253634	0.096138150	0.69138769	3.16395e-02	0.33384300
3	1 - 1 - 3	0.00219992	0.029305379	0.150159443	68.25677412	2.31824e-09	0.76550800
4	1 - 2 - 1	0.15032400	0.114212694	0.124573600	0.82870067	3.10366e-03	0.22041300
5	1 - 2 - 2	0.73855600	0.763918534	0.135787983	0.18385604	1.07505e-01	0.86035800
6	1 - 2 - 3	0.11112000	0.121868789	0.098026771	0.88217036	9.51591e-03	0.31509000
7	1 - 3 - 1	0.00132185	0.022605073	0.134016625	101.38565240	1.95213e-09	0.09778540
8	1 - 3 - 2	0.17721900	0.185540627	0.094100543	0.53098450	3.23069e-02	0.28340600
9	1 - 3 - 3	0.82145900	0.791854281	0.152346284	0.18545817	3.87163e-02	0.89282400
10	2 - 1 - 1	0.86366300	0.778263349	0.108479834	0.12560435	6.60312e-01	0.83654700
11	2 - 1 - 2	0.13411700	0.216035447	0.097634346	0.72797890	1.56645e-01	0.33030400
12	2 - 1 - 3	0.00222005	0.005701201	0.050221032	22.62157683	2.25707e-09	0.01139910
13	2 - 2 - 1	0.17112200	0.108404427	0.096516399	0.56402099	7.76377e-02	0.13747000
14	2 - 2 - 2	0.71157300	0.785301478	0.113391239	0.15935292	7.28224e-01	0.83132000
15	2 - 2 - 3	0.11730500	0.106294104	0.056073926	0.47801821	7.47532e-02	0.14319400
16	2 - 3 - 1	0.00128653	0.008135020	0.072880731	56.64907252	1.97336e-09	0.00953086
17	2 - 3 - 2	0.18045600	0.178751796	0.034325115	0.19021321	1.35227e-01	0.21660500
18	2 - 3 - 3	0.81825700	0.813113189	0.068443272	0.08364520	7.73429e-01	0.85651000
19	3 - 1 - 1	0.86416500	0.794367958	0.078004022	0.09026519	7.20308e-01	0.83632000
20	3 - 1 - 2	0.13369200	0.202850383	0.077499091	0.57968384	1.61298e-01	0.27425300
21	3 - 1 - 3	0.00214275	0.002781672	0.003078915	1.43689873	2.22492e-09	0.01031380
22	3 - 2 - 1	0.15860200	0.111303157	0.086107426	0.54291514	8.36232e-02	0.13610300
23	3 - 2 - 2	0.72709400	0.784623965	0.106354275	0.14627308	7.48975e-01	0.82289900
24	3 - 2 - 3	0.11430400	0.104072870	0.041194049	0.36039026	8.27396e-02	0.12912700
25	3 - 3 - 1	0.00125011	0.003505007	0.029971664	23.97522115	1.97937e-09	0.00967006
26	3 - 3 - 2	0.17041300	0.176877650	0.025534971	0.14984168	1.39422e-01	0.20859200
27	3 - 3 - 3	0.82833700	0.819617364	0.034591402	0.04176006	7.88297e-01	0.85419300
28	4 - 1 - 1	0.85655900	0.809592236	0.068602542	0.08009085	7.23239e-01	0.87446200
29	4 - 1 - 2	0.14129500	0.186205439	0.057174641	0.40464731	1.23471e-01	0.26711100

30	4 - 1 - 3	0.00214524	0.004202307	0.034882509	16.26042272	2.01969e-09	0.01076790
31	4 - 2 - 1	0.13112900	0.107563632	0.053684870	0.40940501	7.19483e-02	0.15511900
32	4 - 2 - 2	0.76152200	0.786581416	0.072924465	0.09576147	7.19185e-01	0.84056000
33	4 - 2 - 3	0.10734900	0.105854943	0.041401200	0.38566917	7.15161e-02	0.15579600
34	4 - 3 - 1	0.00128911	0.002663793	0.003605783	2.79711053	2.21515e-09	0.01133830
35	4 - 3 - 2	0.16675300	0.181904600	0.032441233	0.19454663	1.33687e-01	0.25262900
36	4 - 3 - 3	0.83195800	0.815431606	0.032739341	0.03935216	7.44832e-01	0.86305200
37	5 - 1 - 1	0.84699300	0.810248115	0.062246337	0.07349097	7.56957e-01	0.86032700
38	5 - 1 - 2	0.15080700	0.184356362	0.043805394	0.29047322	1.32299e-01	0.23559900
39	5 - 1 - 3	0.00220055	0.005395526	0.050549643	22.97136754	2.15031e-09	0.01128740
40	5 - 2 - 1	0.11829400	0.106159020	0.052674313	0.44528305	7.45407e-02	0.14245200
41	5 - 2 - 2	0.77793600	0.791369065	0.067591320	0.08688545	7.44394e-01	0.83676200
42	5 - 2 - 3	0.10377000	0.102471916	0.047004166	0.45296489	7.40717e-02	0.13220200
43	5 - 3 - 1	0.00132245	0.005413839	0.049654887	37.54764782	2.15471e-09	0.01115910
44	5 - 3 - 2	0.16596100	0.182869612	0.029927533	0.18032871	1.41181e-01	0.23274600
45	5 - 3 - 3	0.83271600	0.811716543	0.052839502	0.06345441	7.61043e-01	0.84744000
46	6 - 1 - 1	0.83764700	0.808854079	0.049454294	0.05903954	7.33688e-01	0.86804300
47	6 - 1 - 2	0.16010800	0.187484526	0.041459431	0.25894666	1.25229e-01	0.25972900
48	6 - 1 - 3	0.00224500	0.003661396	0.028071492	12.50400540	2.25796e-09	0.01103040
49	6 - 2 - 1	0.11417900	0.101138002	0.020802169	0.18218910	7.06297e-02	0.13542100
50	6 - 2 - 2	0.78697900	0.800940856	0.029180087	0.03707861	7.45357e-01	0.84479100
51	6 - 2 - 3	0.09884210	0.097921157	0.020577681	0.20818742	6.68223e-02	0.14006100
52	6 - 3 - 1	0.00148724	0.002920620	0.004034223	2.71255689	2.08426e-09	0.01160090
53	6 - 3 - 2	0.17561000	0.190472788	0.038186564	0.21745096	1.52733e-01	0.26283000
54	6 - 3 - 3	0.82290300	0.806606587	0.038795028	0.04714411	7.34771e-01	0.84291000
55	7 - 1 - 1	0.84412400	0.822289910	0.061301671	0.07262164	7.79220e-01	0.87972700
56	7 - 1 - 2	0.15366200	0.172561732	0.040230174	0.26180952	1.16825e-01	0.21591100
57	7 - 1 - 3	0.00221412	0.005148347	0.047452490	21.43176049	1.91513e-09	0.01066380
58	7 - 2 - 1	0.10232000	0.106621661	0.042184004	0.41227526	7.93720e-02	0.13957400
59	7 - 2 - 2	0.79828200	0.792007606	0.053735768	0.06731427	7.49000e-01	0.83220800
60	7 - 2 - 3	0.09939880	0.101370753	0.039763384	0.40003887	7.48725e-02	0.13409800
61	7 - 3 - 1	0.00137382	0.005426420	0.047844575	34.82594125	2.17860e-09	0.01190740
62	7 - 3 - 2	0.16343300	0.187241955	0.035646748	0.21811230	1.53949e-01	0.25313000
63	7 - 3 - 3	0.83519400	0.807331627	0.055944751	0.06698414	7.40693e-01	0.84250200
64	8 - 1 - 1	0.85276700	0.825276653	0.075551006	0.08859513	7.73544e-01	0.89922200
65	8 - 1 - 2	0.14471100	0.167485851	0.046806769	0.32344998	9.59859e-02	0.21989400
66	8 - 1 - 3	0.00252204	0.007237498	0.066224362	26.25825188	2.16412e-09	0.01118940
67	8 - 2 - 1	0.08360080	0.106656504	0.041074475	0.49131677	7.24901e-02	0.15472100
68	8 - 2 - 2	0.82279200	0.777164315	0.079698845	0.09686390	7.01091e-01	0.83570900
69	8 - 2 - 3	0.09360690	0.116179192	0.066405752	0.70941087	7.68998e-02	0.17585300
70	8 - 3 - 1	0.00125494	0.003633896	0.029215491	23.28038867	2.02402e-09	0.01138320
71	8 - 3 - 2	0.14289200	0.180587102	0.052569001	0.36789324	1.25373e-01	0.24041100
72	8 - 3 - 3	0.85585300	0.815779007	0.060281090	0.07043393	7.55459e-01	0.86870000
73	9 - 1 - 1	0.86122700	0.834509721	0.069671013	0.08089739	7.79289e-01	0.91101000
74	9 - 1 - 2	0.13642200	0.159345686	0.045182359	0.33119555	8.56052e-02	0.21525300
75	9 - 1 - 3	0.00235114	0.006144591	0.056358639	23.97077123	2.19533e-09	0.01219190
76	9 - 2 - 1	0.09416540	0.106986110	0.030746773	0.32651879	7.60275e-02	0.15553600
77	9 - 2 - 2	0.81267500	0.742139807	0.110391427	0.13583711	6.20728e-01	0.81976500
78	9 - 2 - 3	0.09315930	0.150874080	0.094577937	1.01522808	9.18758e-02	0.26418600
79	9 - 3 - 1	0.00127144	0.002245926	0.004596473	3.61517074	1.72166e-09	0.00985950
80	9 - 3 - 2	0.14352600	0.172968894	0.062587262	0.43606916	1.05970e-01	0.23769200
81	9 - 3 - 3	0.85520200	0.824785183	0.064530292	0.07545620	7.58653e-01	0.89079100

Overall CV on movement
0.02343347

==========
GROWTH PARAMETER FITS
==========

	parameter	observed	expected	RMSE	CV	LR2.5	UP97.5
1	mu_Alpha	5.47	5.4053174	0.0763029	0.01394934	5.333240	5.475990
2	mu_Beta	2.89	2.8621866	2.6081121	0.90246094	2.794850	2.936210
3	theta	1.00	0.9937734	4.4762423	4.47624235	0.959681	1.000000
4	omega	0.80	0.8018384	4.6681629	5.83520366	0.795155	0.808512

Appendix 11: Base-case (homogeneous tag release) simulation analysis summary tables for eight spatial strata programme design.

a. Design scenario: 30% examination of commercial catch; 15000 tags released

```
Mean number of tags released
  stratum     Tags     Cost
1       1 2537.059 39330.93
2       2 1747.797 26958.89
3       3 1214.207 16510.87
4       4 2221.175 30261.28
5       5 3915.569 53158.21
6       6 2305.857 36477.07
7       7 1450.120 23270.61
8       8 1028.948 16427.59
      tot     Tags     Cost
1 Total   16420.73 242395.4

Mean number of fish examined
  stratum Fishexam     Cost
1       1 246671.4 211551.0
2       2 247222.6 211188.0
3       3 259606.1  94316.0
4       4 259286.7  94509.5
5       5 259471.4  94288.0
6       6 189529.1  92758.5
7       7 189768.3  92617.0
8       8 189924.1  92703.5
       tot    exam     Cost
1 Total    1841480 983931.5

Mean number of tags recovered
  stratum     Tags
1       1 33.33031
2       2 34.19537
3       3 37.75428
4       4 38.70493
5       5 39.93454
6       6 27.13897
7       7 27.90634
8       8 28.45418
       tot     tags
1 Total    267.4189

======================================================================
POPULATION FITS
======================================================================

BY STRATUM & LENGTH

Total fits by length bin

   Numbers
```

	stock	stratum	length_bin	true_pop	exp_pop	RMSE	CV	LR2.5	UP97.5	bias
1	1	1	1	9819394.0	17980201.4	69982289.4	7.1269459	60111.50	122912254	1.8310907
2	1	1	2	1858781.0	2396885.2	2765630.3	1.4878731	67299.02	7412470	1.2894931
3	1	1	3	2720390.0	2684620.8	2415279.3	0.8878430	85341.11	9059668	0.9868514
4	1	1	4	853898.0	1479179.8	3066690.8	3.5914017	33601.48	6896396	1.7322676
5	1	1	5	1432697.0	2067355.8	2873942.4	2.0059666	57564.30	9710418	1.4429818
6	1	1	6	1027808.0	1980582.3	3206796.7	3.1200348	41401.58	9688814	1.9269964
7	1	1	7	1848468.0	2483638.8	3284072.1	1.7766454	64610.16	11440800	1.3436201
8	1	1	8	971744.0	1545550.7	3134575.3	3.2257213	34024.86	8022824	1.5904917
9	1	1	9	1038509.6	1132542.9	1548337.5	1.4909227	33405.27	4755648	1.0905465
10	1	2	1	7148476.0	14808258.7	69750437.4	9.7573857	90585.76	73297118	2.0715267
11	1	2	2	1442488.0	2176372.9	2289244.5	1.5870111	93981.50	7350611	1.5087632
12	1	2	3	1932185.0	3242086.8	2688291.0	1.3913217	243834.06	8753482	1.6779381
13	1	2	4	527582.0	1512112.8	2917514.5	5.5299736	43790.74	8705984	2.8661190
14	1	2	5	848039.0	1970803.0	2669472.6	3.1478182	78426.73	7740114	2.3239533
15	1	2	6	662626.0	1698972.9	2848750.3	4.2991829	59905.24	6364682	2.5639997
16	1	2	7	847296.2	2299532.7	3047380.1	3.5965936	104397.82	8730353	2.7139656
17	1	2	8	322543.0	1322847.0	2657800.8	8.2401441	39749.27	5885188	4.1013042
18	1	2	9	397475.0	1008046.4	1504925.9	3.7862149	33942.20	4251393	2.5361252
19	2	3	1	4111469.0	7417555.4	25705483.3	6.2521408	87217.72	43273482	1.8041132
20	2	3	2	680678.0	2346618.2	3275941.5	4.8127624	93824.43	9705358	3.4474717
21	2	3	3	1011278.0	2986686.4	3571180.1	3.5313535	154436.78	11158823	2.9533782

22	2	3	4	375713.0	1128235.1	1939866.5	5.1631604	34093.39	6190392	3.0029173
23	2	3	5	733105.0	1623039.1	2171930.1	2.9626453	65727.22	6469898	2.2139244
24	2	3	6	615578.0	1385797.1	2123439.2	3.4495048	46934.32	6566560	2.2512128
25	2	3	7	928584.0	1943265.1	2482961.9	2.6739228	87151.90	8187357	2.0927187
26	2	3	8	419288.5	1108784.9	1784931.4	4.2570484	35458.10	5249150	2.6444438
27	2	3	9	416626.9	950885.3	1501693.9	3.6044096	25960.26	4687530	2.2823427
28	2	4	1	8545756.0	9192036.8	37712047.5	4.4129563	99680.22	44969811	1.0756259
29	2	4	2	1626135.0	2062340.8	2485353.3	1.5283807	63920.76	8352406	1.2682470
30	2	4	3	2285581.0	2577784.6	2523700.9	1.1041836	130246.24	9413820	1.1278466
31	2	4	4	686659.0	763229.0	1392949.3	2.0285896	25752.07	3804666	1.1115109
32	2	4	5	1183629.0	1257231.5	1712351.3	1.4466959	46267.48	5847710	1.0621838
33	2	4	6	982014.0	1020376.8	1659380.4	1.6897726	37705.07	4556778	1.0390654
34	2	4	7	1416729.0	1522708.1	1962101.4	1.3849518	50402.08	6465784	1.0748055
35	2	4	8	837158.0	921175.5	1810596.0	2.1627888	25381.46	4933272	1.1003604
36	2	4	9	882732.6	956890.7	2231914.7	2.5284155	26545.70	4345482	1.0840097
37	2	5	1	17152130.0	9528001.6	20222237.8	1.1789928	124404.42	49400704	0.5554996
38	2	5	2	3592000.0	3217136.7	3382653.5	0.9417187	121177.23	11193329	0.8956394
39	2	5	3	4465180.0	3675637.5	2854349.8	0.6392463	183371.02	10008347	0.8231779
40	2	5	4	1188960.0	1316326.9	1793281.1	1.5082771	51452.51	5028754	1.1071246
41	2	5	5	1920851.0	1970305.4	2088194.5	1.0871195	77955.53	6921518	1.0257461
42	2	5	6	1454071.0	1598080.0	1867310.3	1.2841948	54975.20	5681807	1.0990385
43	2	5	7	1856569.0	1945839.3	1991071.2	1.0724467	71957.73	7454339	1.0480835
44	2	5	8	792360.0	976496.5	1360625.4	1.7171809	35832.04	4118479	1.2323900
45	2	5	9	930555.8	953365.6	1646632.3	1.7695149	35545.49	3969192	1.0245120
46	3	6	1	9399611.0	25114416.8	109251464.4	11.6229772	81125.33	154153614	2.6718570
47	3	6	2	2008033.0	2713796.3	3486962.9	1.7365068	55381.72	12415582	1.3514700
48	3	6	3	2755678.0	3310277.6	2983053.9	1.0825118	114743.52	11041987	1.2012570
49	3	6	4	726580.0	1218906.0	2941383.7	4.0482586	33158.93	6589730	1.6775937
50	3	6	5	1159637.0	1734225.1	2927529.1	2.5245220	44520.33	7394098	1.4954896
51	3	6	6	816555.0	1337074.4	2602384.0	3.1870285	31771.89	7147458	1.6374579
52	3	6	7	1229585.0	1459977.3	2316412.6	1.8838979	36768.54	6158135	1.1873740
53	3	6	8	560148.0	1003185.5	2599719.6	4.6411299	23425.03	6078952	1.7909294
54	3	6	9	576602.8	964566.3	3935201.3	6.8248039	21749.59	5289961	1.6728435
55	3	7	1	5882663.0	23382261.0	87143593.7	14.8136301	56244.82	198456865	3.9747749
56	3	7	2	1126338.0	1239645.9	2262928.6	2.0091026	35768.93	6119933	1.1005985
57	3	7	3	1453034.0	1300625.5	1525594.5	1.0499372	48011.83	4954377	0.8951101
58	3	7	4	419144.0	1109429.3	3336609.7	7.9605332	16955.21	7994249	2.6468930
59	3	7	5	709752.0	970719.3	1984719.3	2.7963561	25852.90	5223656	1.3676880
60	3	7	6	458265.0	948142.0	2382545.8	5.1990569	21181.08	5390551	2.0689819
61	3	7	7	547681.4	893504.6	2225212.4	4.0629687	28935.15	3977808	1.6314313
62	3	7	8	334529.7	1016491.2	2471569.5	7.3881916	18844.43	7623650	3.0385678
63	3	7	9	501208.9	1347919.2	4108598.6	8.1973777	23936.99	11410093	2.6893362
64	3	8	1	3466915.0	89451875.6	245814002.2	70.9028062	41895.20	937633057	25.8015774
65	3	8	2	631414.0	996262.5	1590998.2	2.5197386	29630.77	3946606	1.5778276
66	3	8	3	835650.0	1006453.3	900905.9	1.0780900	50883.90	2982292	1.2043958
67	3	8	4	250608.0	1410891.6	5394721.2	21.5265321	13917.97	14186981	5.6298746
68	3	8	5	399780.0	935559.1	2360864.0	5.9054079	21392.85	4870527	2.3401849
69	3	8	6	341815.0	1319822.3	5051624.2	14.7788254	20459.82	8350924	3.8612183
70	3	8	7	597344.9	1198180.8	2410699.9	4.0356917	30048.05	7052145	2.0058442
71	3	8	8	396272.7	3173059.3	9157022.5	23.1078813	18872.32	32649988	8.0072619
72	3	8	9	865307.8	4873820.7	11443015.9	13.2242152	43508.10	42818890	5.6324709

Biomass

	stock	stratum	length_bin	true_bio	exp_bio	RMSE_bio	CV_bio	LR2.5	UP97.5	bias
2	1	1	2	704.7022	909.4783	1049.6371	1.4894762	25.5	2813.2	1.2905854
3	1	1	3	1342.9958	1315.0465	1183.4142	0.8811749	41.8	4433.2	0.9791888
4	1	1	4	509.3562	882.3409	1829.3030	3.5914020	20.0	4113.7	1.7322668
5	1	1	5	977.2646	1409.6003	1959.3648	2.0049481	39.2	6623.4	1.4423937
6	1	1	6	831.0901	1604.1331	2597.5843	3.1255145	33.5	7845.4	1.9301554
7	1	1	7	1961.7952	2619.2541	3460.1423	1.7637632	68.2	12074.4	1.3351312
8	1	1	8	1473.8963	2333.8633	4731.4730	3.2101804	51.3	12098.2	1.5834651
9	1	1	9	3090.5890	2989.1446	4082.6904	1.3210072	87.4	12391.2	0.9671764
11	1	2	2	546.1504	825.7876	869.0099	1.5911549	35.7	2789.2	1.5120150
12	1	2	3	949.1864	1588.0824	1315.6446	1.3860761	119.4	4292.4	1.6730985
13	1	2	4	314.7064	901.9872	1740.3179	5.5299728	26.1	5193.2	2.8661228
14	1	2	5	578.4150	1343.7079	1819.7194	3.1460446	53.5	5278.0	2.3230861
15	1	2	6	536.2641	1376.1081	2307.2568	4.3024634	48.5	5153.4	2.5661013
16	1	2	7	877.9498	2425.1018	3221.9347	3.6698394	110.0	9201.5	2.7622330
17	1	2	8	490.2926	1997.4408	4009.5254	8.1778210	59.9	8896.7	4.0739767
18	1	2	9	1223.0119	2659.3633	3907.4797	3.1949647	89.5	11159.2	2.1744379
20	2	3	2	257.9074	891.0938	1244.2126	4.8242616	35.6	3684.0	3.4550924
21	2	3	3	500.8869	1464.6242	1748.6857	3.4911786	75.7	5472.6	2.9240615
22	2	3	4	224.1155	673.0000	1157.1436	5.1631579	20.3	3692.6	3.0029163
23	2	3	5	500.9594	1106.6425	1480.4586	2.9552466	44.8	4411.2	2.2090462
24	2	3	6	498.4988	1121.9396	1718.7945	3.4479409	38.0	5317.3	2.2506363
25	2	3	7	973.0501	2037.3093	2602.7432	2.6748296	91.4	8571.6	2.0937352
26	2	3	8	628.6183	1676.9816	2700.9242	4.2966041	53.7	7923.3	2.6677261
27	2	3	9	1330.7216	2533.2416	3928.0975	2.9518553	70.0	12613.7	1.9036601
29	2	4	2	617.2185	783.1190	943.7987	1.5291161	24.3	3172.1	1.2687874
30	2	4	3	1123.7044	1264.0269	1237.1175	1.1009278	63.8	4612.0	1.1248749
31	2	4	4	409.5970	455.2714	830.9041	2.0285895	15.4	2269.5	1.1115107
32	2	4	5	807.8594	857.2364	1167.6052	1.4453074	31.5	3987.3	1.0611207
33	2	4	6	795.8706	826.0621	1343.0727	1.6875516	30.5	3692.4	1.0379353
34	2	4	7	1485.0560	1596.3353	2056.6866	1.3849219	52.7	6777.0	1.0749328

35	2	4	8	1270.8213	1393.2621	2737.6864	2.1542655	38.4	7440.3	1.0963478
36	2	4	9	2520.8990	2553.8122	5968.1449	2.3674669	71.1	11618.2	1.0130561
38	2	5	2	1361.1085	1221.6498	1284.1883	0.9434871	46.0	4250.7	0.8975404
39	2	5	3	2188.2372	1802.4016	1399.2160	0.6394261	89.9	4905.6	0.8236775
40	2	5	4	709.2231	785.1979	1069.7038	1.5082755	30.7	2999.7	1.1071240
41	2	5	5	1311.2956	1343.4159	1423.7922	1.0857904	53.2	4719.4	1.0244951
42	2	5	6	1176.7196	1293.8681	1511.9253	1.2848645	44.5	4599.6	1.0995551
43	2	5	7	1937.3720	2039.6423	2086.7282	1.0770922	75.5	7812.4	1.0527882
44	2	5	8	1187.4878	1477.0782	2059.6704	1.7344772	54.2	6212.8	1.2438682
45	2	5	9	3263.9906	2544.1914	4468.0623	1.3688956	93.6	10667.7	0.7794727
47	3	6	2	761.2854	1029.3474	1322.7055	1.7374633	21.0	4709.6	1.3521176
48	3	6	3	1352.8026	1620.8482	1459.9655	1.0792154	56.2	5408.0	1.1981410
49	3	6	4	433.4101	727.0864	1754.5547	4.0482550	19.8	3930.8	1.6775944
50	3	6	5	790.4542	1182.0015	1995.0058	2.5238727	30.3	5034.9	1.4953447
51	3	6	6	660.4672	1082.5594	2107.0655	3.1902653	25.7	5787.3	1.6390813
52	3	6	7	1291.9545	1531.9177	2430.7227	1.8814306	38.4	6461.1	1.1857366
53	3	6	8	838.3143	1511.8558	3920.3830	4.6765073	35.3	9174.6	1.8034474
54	3	6	9	2050.4870	2596.2225	10435.0616	5.0890650	58.2	14096.0	1.2661492
56	3	7	2	426.2993	470.1835	858.1384	2.0129950	13.6	2320.8	1.1029422
57	3	7	3	713.8823	636.8508	747.1969	1.0466668	23.5	2430.7	0.8920949
58	3	7	4	250.0224	661.7824	1990.3090	7.9605237	10.1	4768.6	2.6468926
59	3	7	5	483.7935	661.6243	1353.3747	2.7974222	17.6	3559.3	1.3675758
60	3	7	6	369.9720	767.6181	1929.0324	5.2139963	17.2	4367.5	2.0748009
61	3	7	7	575.7413	937.3791	2330.7065	4.0481836	30.4	4174.6	1.6281255
62	3	7	8	512.7729	1531.9708	3721.8726	7.2583260	28.3	11518.6	2.9876206
63	3	7	9	1661.4012	3635.7887	10958.8178	6.5961298	65.3	30623.4	2.1883870
65	3	8	2	239.2613	377.8409	603.2567	2.5213305	11.2	1497.4	1.5791980
66	3	8	3	411.2117	492.8032	440.8073	1.0719717	24.9	1458.9	1.1984173
67	3	8	4	149.4895	841.6082	3217.9892	21.5265305	8.3	8462.6	5.6298832
68	3	8	5	273.0141	637.6420	1609.0277	5.8935694	14.6	3321.9	2.3355641
69	3	8	6	277.1222	1068.6532	4090.4297	14.7603821	16.6	6757.7	3.8562523
70	3	8	7	628.7998	1257.1274	2528.4313	4.0210433	31.6	7415.3	1.9992490
71	3	8	8	606.2867	4780.4093	13786.9874	22.7400474	28.5	49191.9	7.8847344
72	3	8	9	2830.4974	13190.9874	30832.6378	10.8930105	120.4	118038.4	4.6603072

BY STOCK & LENGTH

Total fits by length bin

numbers

	stock	length_bin	true_pop	exp_pop	RMSE	CV	bias
1	1	1	16967870	32788460	98806095	5.8231289	1.9323852
4	1	2	3301269	4573258	3590174	1.0875134	1.3853031
7	1	3	4652575	5926708	3613929	0.7767589	1.2738553
10	1	4	1381480	2991293	4232787	3.0639508	2.1652812
13	1	5	2280736	4038159	3922452	1.7198185	1.7705507
16	1	6	1690434	3679555	4289397	2.5374529	2.1766926
19	1	7	2695764	4783172	4480140	1.6619184	1.7743286
22	1	8	1294287	2868398	4109680	3.1752461	2.2161991
25	1	9	1435985	2140589	2159201	1.5036383	1.4906771
2	2	1	29809355	26137594	49919027	1.6746094	0.8768252
5	2	2	5898813	7626096	5324577	0.9026522	1.2928187
8	2	3	7762039	9240109	5222040	0.6727666	1.1904229
11	2	4	2251332	3207791	2986511	1.3265528	1.4248414
14	2	5	3837585	4850576	3465542	0.9030529	1.2639658
17	2	6	3051663	4004254	3278626	1.0743734	1.3121547
20	2	7	4201882	5411812	3738891	0.8898134	1.2879496
23	2	8	2048807	3006457	2883668	1.4074866	1.4674187
26	2	9	2229915	2861142	3154033	1.4144184	1.2830719
3	3	1	18749189	137948553	282762112	15.0812983	7.3575744
6	3	2	3765785	4949705	4450958	1.1819471	1.3143885
9	3	3	5044362	5617356	3469536	0.6878047	1.1135910
12	3	4	1396332	3739227	6991975	5.0073875	2.6778925
15	3	5	2269169	3640503	4252436	1.8740061	1.6043333
18	3	6	1616635	3605039	6161804	3.8115001	2.2299646
21	3	7	2374611	3551663	4016069	1.6912533	1.4956817
24	3	8	1290950	5192736	9834544	7.6180651	4.0224132
27	3	9	1943119	7186306	12779241	6.5766626	3.6983347

biomass

	stock	length_bin	true_bio	exp_bio	RMSE	CV	bias
1	1	2	1250.8526	1735.266	1362.687	1.0894067	1.387267
4	1	3	2292.1822	2903.129	1769.573	0.7720038	1.266535
7	1	4	824.0626	1784.328	2524.887	3.0639507	2.165282
10	1	5	1555.6796	2753.308	2674.040	1.7188886	1.769843
13	1	6	1367.3543	2980.241	3474.317	2.5409047	2.179568
16	1	7	2839.7450	5044.356	4727.943	1.6649182	1.776341
19	1	8	1964.1889	4331.304	6201.865	3.1574687	2.205136
22	1	9	4313.6008	5648.508	5651.262	1.3101031	1.309465

```
2      2          2 2236.2343  2895.863  2021.871 0.9041407 1.294973
5      2          3 3812.8285  4531.053  2558.548 0.6710367 1.188370
8      2          4 1342.9355  1913.469  1781.474 1.3265520 1.424841
11     2          5 2620.1145  3307.295  2362.677 0.9017458 1.262271
14     2          6 2471.0890  3241.870  2654.057 1.0740433 1.311919
17     2          7 4395.4781  5673.287  3919.013 0.8916012 1.290710
20     2          8 3086.9274  4547.322  4362.586 1.4132456 1.473090
23     2          9 7115.6112  7631.245  8426.879 1.1842804 1.072465
3      3          2 1426.8460  1877.372  1688.156 1.1831381 1.315749
6      3          3 2477.8967  2750.502  1698.268 0.6853667 1.110015
9      3          4  832.9220  2230.477  4170.761 5.0073851 2.677894
12     3          5 1547.2618  2481.268  2898.386 1.8732356 1.603651
15     3          6 1307.5613  2918.831  4989.239 3.8156826 2.232271
18     3          7 2496.4956  3726.424  4211.125 1.6868143 1.492662
21     3          8 1957.3738  7824.236 14808.874 7.5656852 3.997313
24     3          9 6542.3856 19422.999 34345.855 5.2497448 2.968795
```

```
STRATUM FITS +25cm
   numbers
  stratum true_pop  exp_pop     RMSE        CV      bias
1       1 11752296 15770356  8027329 0.6830435 1.3418958
2       2  6980234 15230774  7405142 1.0608731 2.1819862
3       3  5180851 13473311  6934021 1.3383940 2.6005979
4       4  9900638 11081737  5681689 0.5738710 1.1192953
5       5 16200547 15653188  6259392 0.3863692 0.9662136
6       6  9832819 13742009  8524213 0.8669145 1.3975655
7       7  5549953  8826477  7492509 1.3500131 1.5903697
8       8  4318192 14914050 16856561 3.9036152 3.4537715

   biomass
  stratum  true_bio   exp_bio      RMSE        CV      bias
1       1 10891.689 14062.861  8213.580 0.7541144 1.2911552
2       2  5515.977 13117.579  7474.970 1.3551489 2.3781064
3       3  4914.758 11504.832  6371.042 1.2963083 2.3408747
4       4  9031.026  9729.125  7322.732 0.8108416 1.0773001
5       5 13135.434 12507.445  6133.887 0.4669725 0.9521912
6       6  8179.175 11281.839 12064.311 1.4750034 1.3793370
7       7  4993.885  9303.198 12255.164 2.4540342 1.8629180
8       8  5415.683 22647.072 34312.677 6.3357991 4.1817575
```

```
STOCK FITS +25cm
   numbers
  stock true_pop  exp_pop     RMSE        CV     bias
1     1 18732530 31001131 10921270 0.5830110 1.654936
2     2 31282036 40208236 10933536 0.3495149 1.285346
3     3 19700964 37482535 20321013 1.0314730 1.902574

   biomass
  stock true_bio  exp_bio     RMSE        CV     bias
1     1 16407.67 27180.44 11105.77 0.6768645 1.656570
2     2 27081.22 33741.40 11482.04 0.4239852 1.245934
3     3 18588.74 43232.11 38380.94 2.0647410 2.325714
```

```
SNA 1 FITS (25 cm +)
   numbers
  true_pop   exp_pop     RMSE        CV     bias
1 69715530 108691902 25529589 0.3661966 1.559077

   biomass
  true_bio exp_bio     RMSE        CV     bias
1 62077.63  104154 41572.49 0.6696855 1.677802
```

```
================================================================
TAG RECOVERY FITS
================================================================
```

	release	recovery	TagObs	TagExp	RMSE	CV
1	1	1	22.459214502	23.55370959	1.97616680	0.08798913
2	1	2	12.336354481	10.34481469	3.22195583	0.26117568
3	1	3	4.286002014	4.27800593	1.52785138	0.35647472
4	1	4	0.466263847	0.69226362	0.65453417	1.40378494
5	1	5	0.073514602	0.17655830	0.29222335	3.97503818
6	1	6	0.013091641	0.10120510	0.19573856	14.95141482
7	1	7	0.003021148	0.04084133	0.11593284	38.37377003
8	1	8	0.001007049	0.03979977	0.11238729	111.60058087
9	2	1	8.354481370	8.22445410	2.30047118	0.27535775
10	2	2	13.821752266	14.48802413	2.03962326	0.14756619
11	2	3	8.429003021	6.65849891	2.81421545	0.33387287
12	2	4	1.356495468	1.54386180	1.02008787	0.75200242
13	2	5	0.294058409	0.46101318	0.53574222	1.82189051
14	2	6	0.059415911	0.17913697	0.26744812	4.50128792
15	2	7	0.025176234	0.20955741	0.26963128	10.70975462
16	2	8	0.006042296	0.06617932	0.12919505	21.38178036
17	3	1	2.003021148	2.57743066	1.40801493	0.70294561
18	3	2	5.578046324	5.00966885	2.10865442	0.37802741
19	3	3	10.306143001	12.10437829	2.48336054	0.24095925
20	3	4	4.808660624	5.23715662	2.02650910	0.42142901
21	3	5	1.448136959	1.97536009	1.24215034	0.85775750
22	3	6	0.347432024	0.54020376	0.57405572	1.65228211
23	3	7	0.093655589	0.19250607	0.30799580	3.28860027
24	3	8	0.011077543	0.13743811	0.20683557	18.67161100
25	4	1	0.381671702	0.50415998	0.56232029	1.47330883
26	4	2	1.685800604	1.37910440	1.10861669	0.65762029
27	4	3	8.940584089	6.36371032	3.39225861	0.37942248
28	4	4	16.196374622	16.99844773	1.89118480	0.11676593
29	4	5	6.881168177	6.46917487	2.19781333	0.31939538
30	4	6	1.874118832	1.94144976	1.22522471	0.65376042
31	4	7	0.525679758	0.65785124	0.61938315	1.17825186
32	4	8	0.120845921	0.51852122	0.54968319	4.54862840
33	5	1	0.108761329	0.22726163	0.33720277	3.10039212
34	5	2	0.644511581	0.72426629	0.63660276	0.98772897
35	5	3	4.595166163	4.21708369	1.52826690	0.33258142
36	5	4	12.490433031	11.38448953	2.71907933	0.21769296
37	5	5	23.078549849	24.54763095	2.45108880	0.10620636
38	5	6	7.895266868	7.49248765	2.19606499	0.27814956
39	5	7	2.523665660	2.60209494	1.14373154	0.45320248
40	5	8	0.568982880	0.83658648	0.63263881	1.11187670
41	6	1	0.020140987	0.10104137	0.20818551	10.33641041
42	6	2	0.100704935	0.22188333	0.32482051	3.22546771
43	6	3	1.011077543	0.91247603	0.69820050	0.69055090
44	6	4	2.793554884	2.70752294	1.29501867	0.46357373
45	6	5	6.755287009	6.00637612	2.18588448	0.32358129
46	6	6	12.754279960	13.29484663	1.58603895	0.12435347
47	6	7	5.717019134	5.14380710	1.85534443	0.32453004
48	6	8	1.486404834	1.50839279	0.85417666	0.57465950
49	7	1	0.003021148	0.02452298	0.07767096	25.70908870
50	7	2	0.022155086	0.16166170	0.22141786	9.99399691
51	7	3	0.158106747	0.20218391	0.34227049	2.16480633
52	7	4	0.502517623	0.57582607	0.60426560	1.20247644
53	7	5	1.223564955	1.29834590	0.95449223	0.78009118
54	7	6	3.562940584	3.21116055	1.67188787	0.46924382
55	7	7	14.590130916	15.10034125	1.38241857	0.09475025
56	7	8	6.047331319	5.67309714	1.80901473	0.29914265
57	8	1	0.000000000	0.01690898	0.04884849	Inf
58	8	2	0.006042296	0.03600627	0.08998943	14.89325059
59	8	3	0.028197382	0.09958083	0.17970348	6.37305554
60	8	4	0.090634441	0.31810407	0.38111268	4.20494320
61	8	5	0.180261833	0.29070353	0.40598963	2.25222182
62	8	6	0.632426989	0.66875648	0.67536634	1.06789613
63	8	7	4.427995972	4.00878442	1.75878185	0.39719590
64	8	8	20.212487412	19.34067870	1.46903710	0.07267968

	rec_stra	Length_bin	TagObs	TagExp	RMSE	CV
1	1	1	1.560926	1.7098629	0.6952338	0.4453981
2	1	2	5.225579	5.5333219	1.3056024	0.2498484
3	1	3	8.943605	9.4799041	1.6974454	0.1897943
4	1	4	2.141994	2.2654219	0.8132268	0.3796588
5	1	5	3.735146	3.8736009	1.0240809	0.2741743

6	1	6	2.339376	2.4901683	0.8080471	0.3454114
7	1	7	3.733132	3.9137066	1.0899155	0.2919574
8	1	8	2.245720	2.4106130	0.8103388	0.3608370
9	1	9	3.404834	3.5528897	1.0015729	0.2941621
10	2	1	1.690836	1.6298663	0.7952280	0.4703165
11	2	2	5.298087	5.1212616	1.4936848	0.2819291
12	2	3	8.984894	8.6202924	1.9333896	0.2151822
13	2	4	2.143001	2.0929228	0.9752757	0.4550981
14	2	5	3.817724	3.5904005	1.2844657	0.3364480
15	2	6	2.554884	2.3658458	1.0647217	0.4167397
16	2	7	3.998993	3.6696351	1.3526844	0.3382563
17	2	8	2.320242	2.1221253	0.9932031	0.4280602
18	2	9	3.386707	3.1530799	1.2065867	0.3562714
19	3	1	2.098691	1.9071898	0.9967931	0.4749595
20	3	2	5.325277	4.7410131	1.7103595	0.3211776
21	3	3	9.798590	8.8726581	2.3279828	0.2375834
22	3	4	2.867069	2.5793447	1.1763952	0.4103128
23	3	5	4.667674	4.3563323	1.4162841	0.3034240
24	3	6	3.179255	3.0080711	1.1933566	0.3753573
25	3	7	4.456193	4.2669039	1.3658254	0.3065005
26	3	8	2.500504	2.3266323	0.9847333	0.3938140
27	3	9	2.861027	2.7777726	1.1193547	0.3912422
28	4	1	2.260826	2.2408719	0.9331057	0.4127278
29	4	2	5.011078	5.0725554	1.4985762	0.2990527
30	4	3	9.678751	9.8323467	1.9591410	0.2024167
31	4	4	3.011078	3.0667938	1.1100735	0.3686632
32	4	5	4.852971	5.0094812	1.3568813	0.2795981
33	4	6	3.651561	3.6592676	1.1461860	0.3138893
34	4	7	5.025176	5.1304472	1.4342658	0.2854160
35	4	8	2.518630	2.6448057	0.9864722	0.3916701
36	4	9	2.694864	2.8011027	1.0603682	0.3934774
37	5	1	2.137966	2.1846445	0.9034116	0.4225566
38	5	2	4.682779	4.9025034	1.4495825	0.3095560
39	5	3	9.452165	9.9221993	2.0503835	0.2169221
40	5	4	2.983887	3.0588336	1.0268025	0.3441157
41	5	5	5.078550	5.2014998	1.3650770	0.2687927
42	5	6	3.624371	3.7195820	1.2137079	0.3348741
43	5	7	5.567976	5.7460234	1.4313389	0.2570663
44	5	8	3.113797	3.1438231	0.9954233	0.3196816
45	5	9	3.293051	3.3460537	1.0410898	0.3161475
46	6	1	1.205438	1.2916051	0.7139922	0.5923093
47	6	2	3.760322	3.8369985	1.3303465	0.3537852
48	6	3	7.042296	7.0418583	1.7484842	0.2482833
49	6	4	1.838872	1.8418550	0.8770428	0.4769461
50	6	5	3.184290	3.2515422	1.1647793	0.3657893
51	6	6	2.200403	2.2917790	0.9571269	0.4349781
52	6	7	3.667674	3.6726710	1.2838124	0.3500345
53	6	8	1.848943	1.8780562	0.8478406	0.4585543
54	6	9	2.390735	2.3228815	0.9465886	0.3959404
55	7	1	1.020141	0.9959562	0.5904828	0.5788247
56	7	2	4.278953	4.3484089	1.2115126	0.2831330
57	7	3	7.870091	8.1192934	1.7030982	0.2164013
58	7	4	1.832830	1.8603089	0.7919068	0.4320678
59	7	5	3.290030	3.2995337	1.0398589	0.3160636
60	7	6	2.328298	2.2725971	0.8884595	0.3815918
61	7	7	3.838872	3.7782526	1.1797160	0.3073080
62	7	8	1.723061	1.6428871	0.7783761	0.4517402
63	7	9	1.724068	1.6385459	0.7521173	0.4362456
64	8	1	1.023162	0.9790916	0.4875918	0.4765537
65	8	2	4.854985	4.8015862	0.9389374	0.1933966
66	8	3	9.228600	9.0545149	1.2962113	0.1404559
67	8	4	2.126888	2.0704049	0.6283493	0.2954313
68	8	5	3.521652	3.4723182	0.8162865	0.2317908
69	8	6	2.245720	2.2187711	0.6903941	0.3074266
70	8	7	3.181269	3.1979681	0.8526243	0.2680139
71	8	8	1.292044	1.2883020	0.5524353	0.4275668
72	8	9	0.979859	1.0377365	0.5483266	0.5595974

	TagObs	TagExp	RMSE	CV
1	267.4189	266.6194	10.06732	0.03764624

==========

PROPORTIONAL MOVEMENT FITS

Sock movement fits

	Lb__Fr__To	true_mm	geo_obs	RMSE	CV	LR2.5	UP97.5
1	1 - 1 - 1	0.858749000	0.721008569	0.32871252	0.3827807	1.981524e-02	0.99055625
2	1 - 1 - 2	0.139050975	0.166043700	0.19899239	1.4310751	3.637654e-03	0.85014901
3	1 - 1 - 3	0.002199921	0.112947723	0.27309087	124.1366545	1.174946e-06	0.93050126
4	1 - 2 - 1	0.150323860	0.150466818	0.15043443	1.0007356	2.277205e-03	0.55909338
5	1 - 2 - 2	0.738555933	0.638431210	0.28254223	0.3825604	6.652382e-02	0.96046937
6	1 - 2 - 3	0.111120437	0.211101976	0.24589623	2.2128803	6.641006e-03	0.84392166
7	1 - 3 - 1	0.001321854	0.021026387	0.07963054	60.2415471	1.790351e-06	0.26567814
8	1 - 3 - 2	0.177218823	0.151497156	0.16039148	0.9050477	3.695491e-03	0.56103698
9	1 - 3 - 3	0.821458933	0.827476470	0.17100802	0.2081760	3.891969e-01	0.99271157
10	2 - 1 - 1	0.863663500	0.790783554	0.21353985	0.2472489	1.532406e-01	0.98283500
11	2 - 1 - 2	0.134116670	0.199651224	0.20751837	1.5472974	1.296642e-02	0.80240074
12	2 - 1 - 3	0.002220054	0.009565231	0.02840474	12.7946137	4.243023e-06	0.04406656
13	2 - 2 - 1	0.171122367	0.142174000	0.10132843	0.5921402	1.571351e-02	0.35468394
14	2 - 2 - 2	0.711572533	0.720026540	0.19432614	0.2730939	1.499543e-01	0.94840633
15	2 - 2 - 3	0.117304604	0.137799456	0.15083985	1.2858817	1.170304e-02	0.56933462
16	2 - 3 - 1	0.001286535	0.007305388	0.02194121	17.0544982	1.821993e-05	0.03388892
17	2 - 3 - 2	0.180456522	0.182447939	0.13325219	0.7384171	2.016961e-02	0.51513119
18	2 - 3 - 3	0.818257233	0.810246678	0.13583341	0.1660033	4.740765e-01	0.97698159
19	3 - 1 - 1	0.864165500	0.801844151	0.18410629	0.2130452	2.430687e-01	0.97832550
20	3 - 1 - 2	0.133691885	0.192341614	0.18194413	1.3609213	1.680806e-02	0.73586293
21	3 - 1 - 3	0.002142748	0.005814222	0.01022728	4.7729719	4.558811e-06	0.02715737
22	3 - 2 - 1	0.158601927	0.141111088	0.08008420	0.5049384	2.897056e-02	0.31300652
23	3 - 2 - 2	0.727094067	0.734035163	0.13998816	0.1925310	3.881854e-01	0.91834180
24	3 - 2 - 3	0.114303678	0.124853735	0.10361429	0.9064826	1.530264e-02	0.41488613
25	3 - 3 - 1	0.001250112	0.005827794	0.01031494	8.2512158	3.100571e-05	0.02482223
26	3 - 3 - 2	0.170413280	0.169804931	0.11152709	0.6544507	2.786085e-02	0.47953308
27	3 - 3 - 3	0.828336333	0.824367273	0.11253612	0.1358580	5.191384e-01	0.96848771
28	4 - 1 - 1	0.856559500	0.806668038	0.20570012	0.2401469	1.285454e-01	0.98628170
29	4 - 1 - 2	0.141295110	0.169350559	0.18019556	1.2753135	1.075021e-02	0.78037236
30	4 - 1 - 3	0.002145239	0.023981407	0.09362131	43.6414453	4.877152e-06	0.22476815
31	4 - 2 - 1	0.131129173	0.154685844	0.12996583	0.9911282	9.335600e-03	0.48309473
32	4 - 2 - 2	0.761521600	0.700047959	0.21491317	0.2822155	1.410718e-01	0.95105743
33	4 - 2 - 3	0.107349127	0.145266190	0.15758437	1.4679614	8.599518e-03	0.55801214
34	4 - 3 - 1	0.001289106	0.013063213	0.04034677	31.2982473	2.180752e-05	0.11181833
35	4 - 3 - 2	0.166752871	0.161334727	0.14251092	0.8546235	1.087776e-02	0.54669782
36	4 - 3 - 3	0.831958100	0.825602057	0.14919427	0.1793291	4.121673e-01	0.98552513
37	5 - 1 - 1	0.846992500	0.825428973	0.16578437	0.1957330	3.208797e-01	0.98363550
38	5 - 1 - 2	0.150806710	0.163609944	0.16024371	1.0625768	1.180121e-02	0.65917159
39	5 - 1 - 3	0.002200553	0.010961089	0.03553881	16.1499460	4.255891e-06	0.06484479
40	5 - 2 - 1	0.118294067	0.147894419	0.11972116	1.0120639	1.414334e-02	0.42368083
41	5 - 2 - 2	0.777935800	0.716135333	0.20614470	0.2649893	1.412169e-01	0.94344820
42	5 - 2 - 3	0.103770180	0.135970251	0.14308820	1.3788952	1.182272e-02	0.55940350
43	5 - 3 - 1	0.001322451	0.013215447	0.04820828	36.4537346	1.703729e-05	0.11184550
44	5 - 3 - 2	0.165961482	0.173893421	0.13683014	0.8244693	1.679299e-02	0.50820704
45	5 - 3 - 3	0.832716167	0.812891121	0.14457641	0.1736203	4.498483e-01	0.97667063
46	6 - 1 - 1	0.837647500	0.822810753	0.17832907	0.2128927	2.753448e-01	0.98788120
47	6 - 1 - 2	0.160107570	0.163367432	0.16782186	1.0481819	9.177799e-03	0.65198130
48	6 - 1 - 3	0.002245003	0.013821797	0.05488500	24.4476305	7.213761e-06	0.08835721
49	6 - 2 - 1	0.114179020	0.154918767	0.13002354	1.1387691	1.157388e-02	0.48704720
50	6 - 2 - 2	0.786978667	0.715308768	0.21192680	0.2692917	1.384749e-01	0.95342303
51	6 - 2 - 3	0.098842144	0.129772453	0.14630005	1.4801384	9.518745e-03	0.51773097
52	6 - 3 - 1	0.001487237	0.013764890	0.04230017	28.4421252	2.840009e-05	0.12638370
53	6 - 3 - 2	0.175610207	0.169022865	0.12884990	0.7337267	1.207844e-02	0.48367005
54	6 - 3 - 3	0.822902233	0.817212246	0.13443732	0.1633697	4.777931e-01	0.98031175
55	7 - 1 - 1	0.844123500	0.837103348	0.14170668	0.1678743	4.797194e-01	0.98442740
56	7 - 1 - 2	0.153662120	0.154345730	0.13696094	0.8913123	1.143068e-02	0.50582684
57	7 - 1 - 3	0.002214117	0.008550914	0.03604165	16.2781159	2.825546e-06	0.04726021
58	7 - 2 - 1	0.102319653	0.145556532	0.13093924	1.2797076	1.578061e-02	0.46023659
59	7 - 2 - 2	0.798281833	0.741424383	0.18453206	0.2311615	1.910687e-01	0.94812057
60	7 - 2 - 3	0.099398652	0.113019073	0.11619263	1.1689558	9.304661e-03	0.45347064
61	7 - 3 - 1	0.001373821	0.015420269	0.06541486	47.6152592	1.658556e-05	0.14274389
62	7 - 3 - 2	0.163432494	0.174815126	0.13507064	0.8264613	1.591170e-02	0.50035540
63	7 - 3 - 3	0.835193300	0.809764598	0.14774304	0.1768968	4.604433e-01	0.97967505
64	8 - 1 - 1	0.852767500	0.815835442	0.17667425	0.2071775	3.434393e-01	0.98768200
65	8 - 1 - 2	0.144710545	0.161065017	0.15961744	1.1030118	9.367956e-03	0.57555580
66	8 - 1 - 3	0.002522037	0.023099532	0.08086849	32.0647524	5.838627e-06	0.25343488
67	8 - 2 - 1	0.083600687	0.142041218	0.13043711	1.5602397	1.161798e-02	0.45027708
68	8 - 2 - 2	0.822792333	0.718336955	0.22551059	0.2740796	1.511652e-01	0.95095741
69	8 - 2 - 3	0.093606782	0.139621838	0.15772383	1.6849616	8.662394e-03	0.54924298
70	8 - 3 - 1	0.001254936	0.012631113	0.04716521	37.5837517	1.422442e-05	0.08354205
71	8 - 3 - 2	0.142892487	0.151662976	0.13683616	0.9576162	9.332770e-03	0.51684215
72	8 - 3 - 3	0.855852667	0.835705901	0.14762100	0.1724841	4.520807e-01	0.98754861
73	9 - 1 - 1	0.861227500	0.811832843	0.19896578	0.2310258	1.633886e-01	0.98657800
74	9 - 1 - 2	0.136421415	0.148706993	0.15368865	1.1265728	8.438396e-03	0.60964634

```
75  9 - 1 - 3 0.002351138 0.039460156 0.13122446  55.8131682 6.408539e-06 0.42685745
76  9 - 2 - 1 0.094165580 0.131859132 0.11628440   1.2348928 6.516595e-03 0.41064149
77  9 - 2 - 2 0.812675567 0.713385343 0.23313310   0.2868711 1.167470e-01 0.95751633
78  9 - 2 - 3 0.093159383 0.154755522 0.18498267   1.9856580 8.959363e-03 0.65919175
79  9 - 3 - 1 0.001271442 0.007951812 0.02399094  18.8690773 1.784943e-05 0.04083338
80  9 - 3 - 2 0.143526060 0.136912913 0.11444943   0.7974122 9.076468e-03 0.40567360
81  9 - 3 - 3 0.855202467 0.855135281 0.11788800   0.1378481 5.612227e-01 0.98663633


Overall CV on movement
0.05108505


======================================================================
GROWTH PARAMETER FITS
======================================================================
  parameter observed  expected      RMSE         CV    LR2.5   UP97.5
1  mu_Alpha     5.47 5.4241892 0.1335751 0.02441959 5.185040 5.679770
2   mu_Beta     2.89 2.8869639 2.5854586 0.89462237 2.688680 3.123170
3     theta     1.00 0.9737605 4.4964455 4.49644545 0.859199 1.000000
4     omega     0.80 0.8005544 4.6694575 5.83682184 0.777956 0.820864
```

b. Design scenario: 60% examination of commercial catch; 15000 tags released

```
Mean number of tags released
  stratum     Tags     Cost
1       1 2534.559 39251.18
2       2 1747.093 26910.28
3       3 1204.190 16402.57
4       4 2223.621 30149.86
5       5 3917.177 52858.28
6       6 2306.258 36451.52
7       7 1446.531 23165.59
8       8 1027.924 16548.52
      tot     Tags     Cost
1 Total   16407.35 241737.8

Mean number of fish examined
  stratum Fishexam     Cost
1       1 452695.0 408759.0
2       2 452918.2 408779.0
3       3 468236.1 171179.5
4       4 468215.7 171455.0
5       5 467475.6 171085.0
6       6 337003.1 170869.5
7       7 337381.4 170876.0
8       8 336482.5 170765.5
       tot    exam    Cost
1 Total    3320408 1843769

Mean number of tags recovered
  stratum     Tags
1       1 60.81882
2       2 62.65165
3       3 69.34935
4       4 70.47247
5       5 72.84685
6       6 47.89389
7       7 48.85886
8       8 50.64865
       tot     tags
1 Total    483.5405

======================================================================
POPULATION FITS
======================================================================

BY STRATUM & LENGTH

Total fits by length bin
```

Numbers

	stock	stratum	length_bin	true_pop	exp_pop	RMSE	CV	LR2.5	UP97.5	bias
1	1	1	1	9819394.0	7325777.9	15759941.4	1.6049811	74858.20	33832323	0.7460519
2	1	1	2	1858781.0	2089939.3	1756028.8	0.9447207	77499.80	6120996	1.1243601
3	1	1	3	2720390.0	2565674.4	1733784.3	0.6373293	103425.57	6734205	0.9431274
4	1	1	4	853898.0	1137779.1	1571381.2	1.8402446	38255.99	4208268	1.3324532
5	1	1	5	1432697.0	1679213.3	1506601.5	1.0515842	101678.72	5516865	1.1720645
6	1	1	6	1027808.0	1393891.0	1706169.3	1.6600078	54061.37	5527729	1.3561784
7	1	1	7	1848468.0	1823188.1	1491396.8	0.8068286	86793.42	5280831	0.9863238
8	1	1	8	971744.0	974023.4	1129577.6	1.1624230	40335.49	3376297	1.0023457
9	1	1	9	1038509.6	893401.3	869955.5	0.8376962	39631.12	2834014	0.8602726
10	1	2	1	7148476.0	7472402.5	13623396.7	1.9057764	144388.61	35086572	1.0453141
11	1	2	2	1442488.0	2240638.3	1902358.5	1.3188037	177734.35	6440873	1.5533151
12	1	2	3	1932185.0	3203852.2	2421926.6	1.2534652	349669.67	7965340	1.6581498
13	1	2	4	527582.0	1081587.6	1367366.6	2.5917613	72979.24	3753767	2.0500843
14	1	2	5	848039.0	1828869.8	1825043.7	2.1520752	119995.49	5268422	2.1565869
15	1	2	6	662626.0	1488333.2	1595674.1	2.4081067	105460.71	4685427	2.2461136
16	1	2	7	847296.2	2123295.1	2250011.3	2.6555192	137904.82	6132773	2.5059655
17	1	2	8	322543.0	1087305.9	1463455.0	4.5372401	72872.58	3930488	3.3710416
18	1	2	9	397475.0	885997.5	1031134.5	2.5942120	50467.28	2712600	2.2290645
19	2	3	1	4111469.0	4207049.9	5734252.3	1.3946967	133947.39	19941399	1.0232474
20	2	3	2	680678.0	1911689.2	2384109.6	3.5025512	98835.16	6916509	2.8085074
21	2	3	3	1011278.0	2432890.2	2846221.2	2.8144795	182494.19	8941990	2.4057581
22	2	3	4	375713.0	800431.0	1039780.7	2.7674867	50029.41	3217599	2.1304319
23	2	3	5	733105.0	1332443.6	1534890.7	2.0936846	85390.61	4831951	1.8175345
24	2	3	6	615578.0	1206102.9	1433955.6	2.3294458	78851.04	4601979	1.9593016
25	2	3	7	928584.0	1576667.6	1622829.9	1.7476393	111383.12	5659871	1.6979267
26	2	3	8	419288.5	846999.8	1209946.1	2.8857126	41548.01	3400426	2.0200882
27	2	3	9	416626.9	747567.2	884919.0	2.1240084	47170.40	2775785	1.7943325
28	2	4	1	8545756.0	5205817.1	8698348.4	1.0178559	93250.59	24232371	0.6091699
29	2	4	2	1626135.0	1752666.0	1898890.8	1.1677326	74305.11	6678451	1.0778109
30	2	4	3	2285581.0	2230228.0	1835202.7	0.8029480	142471.33	7046718	0.9757817
31	2	4	4	686659.0	613872.3	744434.9	1.0841406	31276.04	2506615	0.8939988
32	2	4	5	1183629.0	1040099.3	1133412.5	0.9575742	53814.27	3981209	0.8787376
33	2	4	6	982014.0	862065.7	1009177.2	1.0276607	45158.50	3445777	0.8778548
34	2	4	7	1416729.0	1274350.7	1329477.4	0.9384134	66186.98	4496090	0.8995021
35	2	4	8	837158.0	696132.4	891315.9	1.0646926	28823.64	2550247	0.8315425
36	2	4	9	882732.6	697263.2	1020943.2	1.1565713	32263.14	2588524	0.7898917
37	2	5	1	17152130.0	7695331.2	13420206.6	0.7824222	137823.99	31216129	0.4486516
38	2	5	2	3592000.0	3095668.9	2346782.2	0.6533358	194314.85	8817076	0.8618232
39	2	5	3	4465180.0	3893767.3	2377400.4	0.5324310	348640.74	8905787	0.8720292
40	2	5	4	1188960.0	1260077.6	1124149.3	0.9454896	62689.53	4085077	1.0598150
41	2	5	5	1920851.0	1913744.2	1405701.1	0.7318116	96531.20	5375426	0.9963002
42	2	5	6	1454071.0	1500292.9	1222048.4	0.8404324	100453.17	4383325	1.0317879
43	2	5	7	1856569.0	1844781.0	1423717.4	0.7668540	94297.62	5223873	0.9936507
44	2	5	8	792360.0	925479.7	988388.0	1.2473976	44476.30	3059476	1.1680041
45	2	5	9	930555.8	840053.5	839179.6	0.9018047	52543.93	2598257	0.9027439
46	3	6	1	9399611.0	11616614.5	57274740.9	6.0933097	80489.05	49794721	1.2358612
47	3	6	2	2008033.0	2474186.5	2381013.0	1.1857440	93336.69	8028880	1.2321444
48	3	6	3	2755678.0	3118548.7	2416568.1	0.8769414	164054.52	9083966	1.1316811
49	3	6	4	726580.0	990596.2	1181983.0	1.6267761	35224.48	4310107	1.3633684
50	3	6	5	1159637.0	1474037.9	1466256.9	1.2644103	55576.35	5279018	1.2711201
51	3	6	6	816555.0	1112546.4	1363137.8	1.6693766	38253.54	4559235	1.3624881
52	3	6	7	1229585.0	1457432.5	1503705.5	1.2229374	57871.08	4732206	1.1853044
53	3	6	8	560148.0	731902.6	1192074.2	2.1281415	28232.13	2987813	1.3066236
54	3	6	9	576602.8	594922.5	844141.9	1.4639920	29912.26	2518151	1.0317716
55	3	7	1	5882663.0	16128983.2	74122168.0	12.6001044	80977.58	116462895	2.7417826
56	3	7	2	1126338.0	963807.6	1203735.7	1.0687163	38253.56	3378520	0.8557002
57	3	7	3	1453034.0	1195664.0	1084637.4	0.7464639	62341.99	3749133	0.8228741
58	3	7	4	419144.0	508821.8	805238.4	1.9211497	19222.41	2540494	1.2139546
59	3	7	5	709752.0	660587.2	968933.8	1.3651723	28010.34	2564892	0.9307296
60	3	7	6	458265.0	577308.2	1463070.7	3.1926303	23335.00	2594623	1.2597695
61	3	7	7	547681.4	677854.6	958636.7	1.7503548	31794.45	3006888	1.2376806
62	3	7	8	334529.7	607087.9	1952080.2	5.8352972	20054.92	3245713	1.8147505
63	3	7	9	501208.9	767734.1	1427586.7	2.8482868	30178.66	4947014	1.5317648
64	3	8	1	3466915.0	41948783.3	147809176.7	42.6342084	99116.09	496591660	12.0997438
65	3	8	2	631414.0	716994.8	607753.2	0.9625272	54636.17	2290685	1.1355383
66	3	8	3	835650.0	885047.3	551437.6	0.6598907	133792.96	2293694	1.0591124
67	3	8	4	250608.0	489092.4	1279356.3	5.1050097	17390.16	2343848	1.9516235
68	3	8	5	399780.0	650752.6	1008279.4	2.5220857	34896.26	2414381	1.6277769
69	3	8	6	341815.0	704379.8	2245746.6	6.5700645	22831.73	2497872	2.0607048
70	3	8	7	597344.9	837309.9	986006.5	1.6506485	55944.57	2774750	1.4017194
71	3	8	8	396272.7	1440431.3	4542746.5	11.4636878	26268.71	11388723	3.6349497
72	3	8	9	865307.8	3162912.0	7600070.4	8.7830837	52547.52	26270566	3.6552451

biomass

	stock	stratum	length_bin	true_bio	exp_bio	RMSE_bio	CV_bio	LR2.5	UP97.5	bias
2	1	1	2	704.7022	793.0101	666.4127	0.9456657	29.4	2323.6	1.1253124
3	1	1	3	1342.9958	1256.7332	850.2020	0.6330638	50.6	3300.8	0.9357685
4	1	1	4	509.3562	678.6937	937.3410	1.8402465	22.8	2510.3	1.3324539
5	1	1	5	977.2646	1144.9687	1027.2367	1.0511347	69.3	3762.4	1.1716056
6	1	1	6	831.0901	1129.0333	1382.3177	1.6632585	43.8	4477.9	1.3584968
7	1	1	7	1961.7952	1923.4801	1573.7812	0.8022148	91.6	5562.3	0.9804693
8	1	1	8	1473.8963	1470.9226	1705.8390	1.1573671	61.0	5099.4	0.9979825

9	1	1	9	3090.5890	2354.6543	2373.9020	0.7681067	103.2	7506.3	0.7618788
11	1	2	2	546.1504	850.2285	722.3745	1.3226658	67.5	2445.3	1.5567663
12	1	2	3	949.1864	1569.3843	1185.0209	1.2484596	171.3	3901.8	1.6533995
13	1	2	4	314.7064	645.1744	815.6451	2.5917653	43.5	2239.1	2.0500834
14	1	2	5	578.4150	1247.0338	1244.3038	2.1512302	81.9	3591.9	2.1559500
15	1	2	6	536.2641	1205.5436	1292.7044	2.4105740	85.4	3795.3	2.2480408
16	1	2	7	877.9498	2240.3072	2383.3353	2.7146602	145.7	6473.9	2.5517487
17	1	2	8	490.2926	1642.0206	2208.4021	4.5042532	110.0	5954.3	3.3490624
18	1	2	9	1223.0119	2336.5938	2638.5577	2.1574261	132.6	7124.6	1.9105242
20	2	3	2	257.9074	725.9611	905.5797	3.5112594	37.5	2625.4	2.8148132
21	2	3	3	500.8869	1193.0169	1393.2938	2.7816534	89.4	4380.3	2.3818089
22	2	3	4	224.1155	477.4640	620.2385	2.7674953	29.8	1919.3	2.1304373
23	2	3	5	500.9594	908.4981	1046.0776	2.0881484	58.2	3293.9	1.8135164
24	2	3	6	498.4988	976.5099	1160.9855	2.3289634	63.9	3727.5	1.9589011
25	2	3	7	973.0501	1652.7260	1701.0553	1.7481683	116.7	5925.6	1.6985004
26	2	3	8	628.6183	1281.3221	1833.2678	2.9163448	62.8	5154.4	2.0383149
27	2	3	9	1330.7216	1995.3606	2285.0040	1.7171165	124.5	7579.8	1.4994576
29	2	4	2	617.2185	665.6020	721.1241	1.1683450	28.2	2535.6	1.0783897
30	2	4	3	1123.7044	1093.5730	899.9754	0.8009004	69.9	3453.6	0.9731856
31	2	4	4	409.5970	366.1793	444.0603	1.0841397	18.7	1495.2	0.8939990
32	2	4	5	807.8594	709.1617	772.8702	0.9566890	36.7	2713.5	0.8778281
33	2	4	6	795.8706	697.9547	817.1543	1.0267427	36.6	2790.5	0.8769700
34	2	4	7	1485.0560	1335.8430	1394.0121	0.9386933	69.4	4709.1	0.8995237
35	2	4	8	1270.8213	1053.0968	1349.0805	1.0615816	43.6	3852.7	0.8286742
36	2	4	9	2520.8990	1859.5963	2757.0908	1.0936935	86.6	6902.4	0.7376719
38	2	5	2	1361.1085	1175.6067	890.5223	0.6542625	73.8	3346.5	0.8637127
39	2	5	3	2188.2372	1909.4217	1165.4812	0.5326119	171.1	4362.2	0.8725845
40	2	5	4	709.2231	751.6453	670.5627	0.9454891	37.4	2436.8	1.0598151
41	2	5	5	1311.2956	1304.8479	958.4544	0.7309217	65.8	3668.5	0.9950830
42	2	5	6	1176.7196	1214.7221	989.5043	0.8409006	81.4	3547.4	1.0322953
43	2	5	7	1937.3720	1934.0094	1492.6245	0.7704377	98.8	5478.7	0.9982644
44	2	5	8	1187.4878	1400.0605	1496.8096	1.2604842	67.1	4623.8	1.1790104
45	2	5	9	3263.9906	2240.8867	2449.5641	0.7504814	138.9	6975.1	0.6865481
47	3	6	2	761.2854	938.4323	903.1139	1.1863013	35.4	3044.6	1.2326945
48	3	6	3	1352.8026	1527.0077	1182.8550	0.8743736	80.4	4445.5	1.1287735
49	3	6	4	433.4101	590.8984	705.0629	1.6267800	21.0	2571.0	1.3633701
50	3	6	5	790.4542	1004.6620	999.3193	1.2642343	37.9	3597.7	1.2709933
51	3	6	6	660.4672	900.8268	1103.8452	1.6713097	31.0	3691.6	1.3639237
52	3	6	7	1291.9545	1529.4272	1577.5696	1.2210721	60.6	4965.2	1.1838089
53	3	6	8	838.3143	1103.3664	1801.1270	2.1485104	42.7	4499.9	1.3161726
54	3	6	9	2050.4870	1610.7164	2322.0760	1.1324510	81.4	6787.4	0.7855287
56	3	7	2	426.2993	365.5819	456.5671	1.0710014	14.5	1281.0	0.8575709
57	3	7	3	713.8823	585.4474	531.6744	0.7447647	30.5	1835.9	0.8200896
58	3	7	4	250.0224	303.5156	480.3296	1.9211466	11.5	1515.4	1.2139538
59	3	7	5	483.7935	450.2604	660.6048	1.3654685	19.1	1747.9	0.9306871
60	3	7	6	369.9720	467.4237	1184.5797	3.2018094	18.9	2101.3	1.2634031
61	3	7	7	575.7413	711.3541	1005.7593	1.7468946	33.3	3148.5	1.2355446
62	3	7	8	512.7729	914.5555	2932.7589	5.7194114	30.2	4890.0	1.7835489
63	3	7	9	1661.4012	2079.8178	3831.0892	2.3059387	83.3	13373.8	1.2518456
65	3	8	2	239.2613	271.9626	230.5680	0.9636662	20.7	868.0	1.1366761
66	3	8	3	411.2117	433.3372	269.7645	0.6560233	65.5	1122.4	1.0538057
67	3	8	4	149.4895	291.7472	763.1454	5.1050114	10.4	1398.1	1.9516243
68	3	8	5	273.0141	443.5288	687.0188	2.5164222	23.8	1646.0	1.6245637
69	3	8	6	277.1222	570.3057	1818.2679	6.5612491	18.5	2022.0	2.0579574
70	3	8	7	628.7998	878.6260	1033.7569	1.6440159	58.7	2909.3	1.3973064
71	3	8	8	606.2867	2171.4973	6847.3492	11.2939137	39.6	17119.4	3.5816346
72	3	8	9	2830.4974	8591.1703	20576.0770	7.2694209	145.0	70917.0	3.0352157

BY STOCK & LENGTH

Total fits by length bin

	numbers						
	stock	length_bin	true_pop	exp_pop	RMSE	CV	bias
1	1	1	16967870	14798180	20832011	1.2277328	0.8721295
4	1	2	3301269	4330578	2588939	0.7842254	1.3117918
7	1	3	4652575	5769527	2978546	0.6401930	1.2400717
10	1	4	1381480	2219367	2083010	1.5078104	1.6065138
13	1	5	2280736	3508083	2366566	1.0376324	1.5381364
16	1	6	1690434	2882224	2336063	1.3819308	1.7050203
19	1	7	2695764	3946483	2699410	1.0013525	1.4639571
22	1	8	1294287	2061329	1848688	1.4283445	1.5926369
25	1	9	1435985	1779399	1349096	0.9394922	1.2391489
2	2	1	29809355	17108198	16989552	0.5699403	0.5739204
5	2	2	5898813	6760024	3846707	0.6521154	1.1459974
8	2	3	7762039	8556886	4137750	0.5330752	1.1024018

```
11     2          4  2251332  2674381   1702656 0.7562885 1.1879105
14     2          5  3837585  4286287   2369917 0.6175544 1.1169230
17     2          6  3051663  3568462   2137304 0.7003736 1.1693498
20     2          7  4201882  4695799   2535362 0.6033871 1.1175467
23     2          8  2048807  2468612   1798701 0.8779261 1.2049024
26     2          9  2229915  2284884   1590481 0.7132472 1.0246505
3      3          1 18749189 69694381 174991555 9.3332867 3.7171944
6      3          2  3765785  4154989   2736342 0.7266325 1.1033527
9      3          3  5044362  5199260   2705610 0.5363631 1.0307072
12     3          4  1396332  1988510   1918918 1.3742560 1.4240957
15     3          5  2269169  2785378   2026171 0.8929133 1.2274880
18     3          6  1616635  2394234   3007008 1.8600415 1.4809988
21     3          7  2374611  2972597   2037725 0.8581299 1.2518247
24     3          8  1290950  2779422   5086079 3.9397946 2.1530044
27     3          9  1943119  4525569   7778923 4.0033171 2.3290223


   biomass
   stock length_bin  true_bio   exp_bio       RMSE        CV      bias
1      1          2 1250.8526  1643.239   982.8178 0.7857183 1.3136949
4      1          3 2292.1822  2826.118  1458.4643 0.6362776 1.2329375
7      1          4  824.0626  1323.868  1242.5318 1.5078123 1.6065139
10     1          5 1555.6796  2392.003  1613.5388 1.0371922 1.5375933
13     1          6 1367.3543  2334.577  1892.5874 1.3841236 1.7073680
16     1          7 2839.7450  4163.787  2856.0593 1.0057450 1.4662539
19     1          8 1964.1889  3112.943  2790.5066 1.4206915 1.5848492
22     1          9 4313.6008  4691.248  3549.2813 0.8228117 1.0875480
2      2          2 2236.2343  2567.170  1460.5220 0.6531167 1.1479878
5      2          3 3812.8285  4196.012  2027.2074 0.5316807 1.1004984
8      2          4 1342.9355  1595.289  1015.6474 0.7562890 1.1879115
11     2          5 2620.1145  2922.508  1615.6242 0.6166235 1.1154122
14     2          6 2471.0890  2889.187  1730.5338 0.7003122 1.1691957
17     2          7 4395.4781  4922.578  2657.9667 0.6047048 1.1199188
20     2          8 3086.9274  3734.479  2724.2114 0.8824993 1.2097723
23     2          9 7115.6112  6095.844  4338.5662 0.6097250 0.8566859
3      3          2 1426.8460  1575.977  1037.8969 0.7274064 1.1045178
6      3          3 2477.8967  2545.792  1324.6118 0.5345710 1.0274006
9      3          4  832.9220  1186.161  1144.6489 1.3742571 1.4240965
12     3          5 1547.2618  1898.451  1380.9535 0.8925144 1.2269747
15     3          6 1307.5613  1938.556  2434.7076 1.8620217 1.4825739
18     3          7 2496.4956  3119.407  2137.5058 0.8562025 1.2495144
21     3          8 1957.3738  4189.419  7663.6365 3.9152646 2.1403265
24     3          9 6542.3856 12281.705 21058.1155 3.2187212 1.8772517
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STRATUM FITS +25cm
   numbers
  stratum true_pop  exp_pop    RMSE        CV      bias
1       1 11752296 12557110 4242261 0.3609730 1.0684815
2       2  6980234 13939880 5049637 0.7234195 1.9970504
3       3  5180851 10854791 4915165 0.9487176 2.0951752
4       4  9900638  9166678 3665417 0.3702203 0.9258674
5       5 16200547 15273865 4427260 0.2732784 0.9427994
6       6  9832819 11954173 4616157 0.4694643 1.2157423
7       7  5549953  5958866 3622270 0.6526668 1.0736786
8       8  4318192  8886920 9366965 2.1691866 2.0580186

   biomass
  stratum  true_bio   exp_bio      RMSE        CV      bias
1       1 10891.689 10751.496  4004.205 0.3676386 0.9871284
2       2  5515.977 11736.286  4830.121 0.8756601 2.1276896
3       3  4914.758  9210.859  4130.848 0.8404988 1.8741225
4       4  9031.026  7781.007  3762.588 0.4166291 0.8615861
5       5 13135.434 11931.200  3868.787 0.2945306 0.9083217
6       6  8179.175  9205.337  4006.720 0.4898685 1.1254603
7       7  4993.885  5877.956  5181.829 1.0376348 1.1770308
8       8  5415.683 13652.175 21813.212 4.0277862 2.5208595
```

STOCK FITS +25cm

numbers

	stock	true_pop	exp_pop	RMSE	CV	bias
1	1	18732530	26496989	6595121	0.3520678	1.414491
2	2	31282036	35295334	7562722	0.2417593	1.128294
3	3	19700964	26799959	11053044	0.5610408	1.360337

biomass

	stock	true_bio	exp_bio	RMSE	CV	bias
1	1	16407.67	22487.78	6274.052	0.3823854	1.370566
2	2	27081.22	28923.07	6796.212	0.2509566	1.068012
3	3	18588.74	28735.47	22775.455	1.2252284	1.545853

SNA 1 FITS (25 cm +)

numbers

	true_pop	exp_pop	RMSE	CV	bias
1	69715530	88592283	14928501	0.2141345	1.270768

biomass

	true_bio	exp_bio	RMSE	CV	bias
1	62077.63	80146.32	24581.98	0.3959877	1.291066

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TAG RECOVERY FITS

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	release	recovery	TagObs	TagExp	RMSE	CV
1	1	1	41.255255255	42.29505949	2.52620592	0.06123355
2	1	2	22.334334334	19.77077173	4.40758305	0.19734562
3	1	3	7.923923924	7.87969367	2.10538864	0.26570026
4	1	4	0.824824825	1.09710723	0.82645167	1.00197235
5	1	5	0.131131131	0.24795767	0.37107488	2.82980000
6	1	6	0.023023023	0.13573256	0.25344890	11.00849785
7	1	7	0.010010010	0.04268024	0.12390653	12.37826268
8	1	8	0.003003003	0.04485313	0.15011384	49.98790824
9	2	1	15.140140140	15.73339998	3.43016536	0.22656100
10	2	2	25.511511512	25.42142541	2.79421976	0.10952780
11	2	3	15.455455455	13.00775705	3.82213014	0.24729974
12	2	4	2.555555556	2.93839812	1.39622372	0.54634841
13	2	5	0.535535536	0.75862894	0.71760269	1.33997212
14	2	6	0.127127127	0.26447608	0.36505919	2.87160735
15	2	7	0.036036036	0.28007062	0.34942916	9.69665917
16	2	8	0.003003003	0.08758044	0.14490103	48.25204420
17	3	1	3.544544545	4.78706460	2.15590866	0.60823291
18	3	2	10.330330330	9.82492915	2.88298691	0.27907984
19	3	3	18.679679680	20.74722943	3.13894211	0.16804047
20	3	4	8.942942943	10.35479686	2.99258015	0.33463035
21	3	5	2.627627628	3.74150613	1.87496517	0.71355817
22	3	6	0.622622623	0.96445664	0.84681285	1.36007402
23	3	7	0.160160160	0.31390177	0.40155337	2.50719888
24	3	8	0.042042042	0.22510160	0.29922451	7.11726867
25	4	1	0.652652653	0.81645968	0.74158270	1.13625939
26	4	2	3.115115115	2.68285585	1.42817713	0.45846689
27	4	3	16.486486486	12.70188977	4.80650755	0.29154226
28	4	4	29.578578579	30.18950968	2.46890605	0.08346939
29	4	5	12.769769770	12.25124277	2.99882654	0.23483795
30	4	6	3.252252252	3.49181797	1.60586923	0.49377142
31	4	7	0.941941942	1.12521105	0.83267767	0.88400106
32	4	8	0.208208208	0.77615747	0.74913234	3.59799621
33	5	1	0.191191191	0.33336015	0.42392347	2.21727510
34	5	2	1.094094094	1.21495365	0.80958696	0.73996100
35	5	3	8.675675676	8.06968604	2.05204080	0.23652807
36	5	4	22.537537538	21.55637385	3.40354901	0.15101690
37	5	5	42.137137137	43.15680237	2.94791799	0.06996009
38	5	6	14.022022022	13.83476974	2.88121465	0.20547783
39	5	7	4.126126126	4.53594384	1.55543061	0.37697117
40	5	8	1.003003003	1.39314920	0.90970529	0.90698162
41	6	1	0.027027027	0.13832946	0.26286540	9.72601962
42	6	2	0.223223223	0.33511200	0.41358337	1.85277930
43	6	3	1.775775776	1.66271990	0.99859510	0.56234301
44	6	4	4.979979980	4.96182785	1.76576314	0.35457234
45	6	5	12.010010010	11.33002526	2.82074898	0.23486650

46	6	6	22.580580581	22.43931885	2.07944307	0.09208989
47	6	7	9.967967968	9.53649961	2.31173498	0.23191637
48	6	8	2.527527528	2.62045376	1.11641244	0.44170140
49	7	1	0.007007007	0.02703559	0.09532350	13.60402553
50	7	2	0.038038038	0.22453901	0.29038281	7.63401129
51	7	3	0.300300300	0.33227596	0.42152643	1.40368301
52	7	4	0.896896897	0.99073895	0.81810855	0.91215451
53	7	5	2.277277277	2.29440512	1.34242790	0.58948812
54	7	6	6.214214214	5.92414386	2.04114086	0.32846323
55	7	7	25.922922923	26.35622781	1.68924775	0.06516425
56	7	8	11.027027027	10.68440732	2.37252797	0.21515572
57	8	1	0.001001001	0.01994728	0.07539345	75.31805200
58	8	2	0.005005005	0.04892616	0.09880741	19.74172041
59	8	3	0.052052052	0.16483825	0.25133857	4.82860061
60	8	4	0.156156156	0.47300356	0.51574380	3.30274392
61	8	5	0.358358358	0.48616250	0.57129112	1.59418946
62	8	6	1.052052052	1.15036592	0.94066194	0.89412111
63	8	7	7.693693694	7.55178218	2.27113978	0.29519498
64	8	8	35.834834835	34.15361003	2.30195469	0.06423790

	rec_stra	Length_bin	TagObs	TagExp	RMSE	CV
1	1	1	2.823824	3.062847	1.0284774	0.3642144
2	1	2	9.427427	9.980341	1.7772440	0.1885185
3	1	3	15.977978	16.984189	2.4547402	0.1536327
4	1	4	3.972973	4.174972	1.0844824	0.2729650
5	1	5	6.636637	6.881245	1.4241822	0.2145940
6	1	6	4.358358	4.628460	1.1583330	0.2657728
7	1	7	6.991992	7.306712	1.5215065	0.2176070
8	1	8	4.362362	4.543785	1.1620171	0.2663734
9	1	9	6.267267	6.588106	1.4492012	0.2312333
10	2	1	3.100100	3.003879	1.2154301	0.3920616
11	2	2	9.570571	9.194463	2.1437538	0.2239944
12	2	3	16.415415	15.772056	2.8124500	0.1713298
13	2	4	4.097097	3.916160	1.3363288	0.3261648
14	2	5	6.695696	6.408281	1.7799172	0.2658301
15	2	6	4.657658	4.268965	1.5081733	0.3238051
16	2	7	7.340340	6.822350	1.9513820	0.2658435
17	2	8	4.312312	4.090510	1.4429710	0.3346165
18	2	9	6.462462	6.046849	1.7718645	0.2741779
19	3	1	3.841842	3.545714	1.4132230	0.3678504
20	3	2	9.573574	8.733408	2.3881701	0.2494544
21	3	3	18.495495	16.782380	3.5407744	0.1914398
22	3	4	5.212212	4.857126	1.6195573	0.3107236
23	3	5	8.434434	7.943171	1.9986552	0.2369637
24	3	6	5.547548	5.358340	1.6171147	0.2915008
25	3	7	8.365365	7.979728	2.0052721	0.2397112
26	3	8	4.545546	4.284091	1.4984440	0.3296511
27	3	9	5.333333	5.082132	1.5816705	0.2965632
28	4	1	4.153153	4.116814	1.2621788	0.3039086
29	4	2	9.055055	9.269376	2.0312090	0.2243177
30	4	3	17.664665	18.103790	2.7232843	0.1541656
31	4	4	5.640641	5.638450	1.4980758	0.2655861
32	4	5	9.087087	9.361397	2.0190816	0.2221924
33	4	6	6.297297	6.465090	1.6159227	0.2566058
34	4	7	9.033033	9.500707	2.0595852	0.2280059
35	4	8	4.626627	4.846158	1.4220365	0.3073592
36	4	9	4.914915	5.259972	1.5358619	0.3124900
37	5	1	3.662663	3.780917	1.2285499	0.3354253
38	5	2	8.754755	8.921261	2.0127237	0.2299006
39	5	3	17.194194	17.812390	2.7240526	0.1584286
40	5	4	5.331331	5.453403	1.5096301	0.2831619
41	5	5	9.288288	9.416959	1.9325374	0.2080617
42	5	6	6.691692	6.746255	1.6154784	0.2414155
43	5	7	10.256256	10.423695	1.8904094	0.1843177
44	5	8	5.502503	5.549596	1.4074732	0.2557878
45	5	9	6.165165	6.162254	1.4576956	0.2364406
46	6	1	2.300300	2.414341	0.9774564	0.4249256
47	6	2	6.490490	6.634072	1.7620426	0.2714807
48	6	3	12.351351	12.330166	2.4315197	0.1968626
49	6	4	3.132132	3.262892	1.2419269	0.3965117
50	6	5	5.655656	5.676828	1.6535992	0.2923797
51	6	6	3.886887	3.957311	1.3507763	0.3475214
52	6	7	6.389389	6.361666	1.5847245	0.2480244
53	6	8	3.439439	3.394299	1.1515854	0.3348178
54	6	9	4.248248	4.173509	1.2114047	0.2851539
55	7	1	1.739740	1.729927	0.8477627	0.4872928

```
56        7          2  7.470470  7.757469 1.6231905 0.2172809
57        7          3 13.684685 14.236694 2.4486292 0.1789321
58        7          4  3.291291  3.397853 1.0918813 0.3317486
59        7          5  5.784785  5.940516 1.4224212 0.2458901
60        7          6  4.148148  4.159867 1.1870437 0.2861623
61        7          7  6.640641  6.557160 1.5523836 0.2337702
62        7          8  3.164164  3.138516 1.0263849 0.3243779
63        7          9  2.934935  2.824314 0.9653167 0.3289057
64        8          1  1.719720  1.638611 0.7055239 0.4102552
65        8          2  8.889890  8.694013 1.2812206 0.1441211
66        8          3 16.366366 16.105911 1.7193747 0.1050554
67        8          4  3.706707  3.603142 0.8555835 0.2308204
68        8          5  6.168168  6.064164 1.1029358 0.1788109
69        8          6  4.084084  4.023283 0.9096782 0.2227374
70        8          7  5.636637  5.653323 1.1096869 0.1968704
71        8          8  2.389389  2.409776 0.7528456 0.3150786
72        8          9  1.687688  1.793089 0.7285647 0.4316940

    TagObs   TagExp     RMSE         CV
1 483.5405 483.0015 14.10516 0.02917058
```

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================================================================
PROPORTIONAL MOVEMENT FITS
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Sock movement fits

	Lb__Fr__To	true_mm	geo_obs	RMSE	CV	LR2.5	UP97.5
1	1 - 1 - 1	0.858749000	0.752276831	0.290029134	0.3377345	2.644009e-02	0.98482350
2	1 - 1 - 2	0.139050975	0.168908168	0.188097102	1.3527205	9.885385e-03	0.78856174
3	1 - 1 - 3	0.002199921	0.078815013	0.226423564	102.9234835	1.281436e-06	0.89915608
4	1 - 2 - 1	0.150323860	0.167001151	0.144548773	0.9615824	5.036180e-03	0.54919455
5	1 - 2 - 2	0.738555933	0.633650366	0.271936386	0.3682001	6.665346e-02	0.94924923
6	1 - 2 - 3	0.111120437	0.199348497	0.227910587	2.0510231	6.661885e-03	0.75933651
7	1 - 3 - 1	0.001321854	0.019849883	0.088011680	66.5819925	2.888313e-06	0.21333488
8	1 - 3 - 2	0.177218823	0.155242132	0.142211973	0.8024654	7.264745e-03	0.50033346
9	1 - 3 - 3	0.821458933	0.824907985	0.162447310	0.1977546	4.108060e-01	0.98970091
10	2 - 1 - 1	0.863663500	0.809867388	0.166654375	0.1929622	3.837879e-01	0.97832100
11	2 - 1 - 2	0.134116670	0.184128540	0.164320462	1.2252054	1.823904e-02	0.60500447
12	2 - 1 - 3	0.002220054	0.006004072	0.010289282	4.6346984	7.154500e-06	0.02726839
13	2 - 2 - 1	0.171122367	0.151219340	0.085357012	0.4988069	3.076914e-02	0.32155137
14	2 - 2 - 2	0.711572533	0.713668792	0.157836724	0.2218140	2.234221e-01	0.91683730
15	2 - 2 - 3	0.117304604	0.135111853	0.122440797	1.0437851	1.606905e-02	0.52243816
16	2 - 3 - 1	0.001286535	0.005464984	0.009299624	7.2284279	3.239919e-05	0.02099596
17	2 - 3 - 2	0.180456522	0.181899523	0.112014245	0.6207271	3.206245e-02	0.44574239
18	2 - 3 - 3	0.818257233	0.812635497	0.112960284	0.1380498	5.444404e-01	0.96203543
19	3 - 1 - 1	0.864165500	0.817947188	0.154211707	0.1784516	3.954432e-01	0.96921200
20	3 - 1 - 2	0.133691885	0.177143146	0.152762888	1.1426489	2.721595e-02	0.59531116
21	3 - 1 - 3	0.002142748	0.004909665	0.006026089	2.8123180	2.028293e-05	0.01600663
22	3 - 2 - 1	0.158601927	0.152013457	0.065659905	0.4139918	3.963016e-02	0.28628463
23	3 - 2 - 2	0.727094067	0.723747734	0.116339709	0.1600064	4.286928e-01	0.89391120
24	3 - 2 - 3	0.114303678	0.124238813	0.092731225	0.8112707	2.076432e-02	0.38476462
25	3 - 3 - 1	0.001250112	0.005046267	0.006211693	4.9689100	1.288859e-04	0.01620986
26	3 - 3 - 2	0.170413280	0.170710183	0.088073871	0.5168252	4.434221e-02	0.40019629
27	3 - 3 - 3	0.828336333	0.824243543	0.089015437	0.1074629	5.945298e-01	0.95076662
28	4 - 1 - 1	0.856559500	0.833561840	0.149027364	0.1739837	4.414112e-01	0.98196700
29	4 - 1 - 2	0.141295110	0.157765257	0.143764743	1.0174785	1.459012e-02	0.50871334
30	4 - 1 - 3	0.002145239	0.008672905	0.032887656	15.3305358	5.659492e-06	0.04373927
31	4 - 2 - 1	0.131129173	0.153433305	0.102902364	0.7847404	2.237545e-02	0.38882193
32	4 - 2 - 2	0.761521600	0.712197676	0.171774702	0.2255677	2.539234e-01	0.92787940
33	4 - 2 - 3	0.107349127	0.134369016	0.126402743	1.1774920	1.365324e-02	0.45981264
34	4 - 3 - 1	0.001289106	0.008015411	0.027191873	21.0935860	1.945522e-05	0.03213284
35	4 - 3 - 2	0.166752871	0.171468289	0.114824645	0.6885917	2.237343e-02	0.46685795
36	4 - 3 - 3	0.831958100	0.820516292	0.118184189	0.1420555	5.153089e-01	0.97455323
37	5 - 1 - 1	0.846992500	0.840954559	0.122017491	0.1440597	5.295972e-01	0.97607450
38	5 - 1 - 2	0.150806710	0.153522666	0.121036027	0.8025905	2.168522e-02	0.46458469
39	5 - 1 - 3	0.002200553	0.005522775	0.009759855	4.4351838	6.524924e-06	0.02284001
40	5 - 2 - 1	0.118294067	0.155862052	0.104380046	0.8823777	2.906099e-02	0.36398152
41	5 - 2 - 2	0.777935800	0.719192985	0.173833343	0.2234546	2.508737e-01	0.91765213
42	5 - 2 - 3	0.103770180	0.124944971	0.118089977	1.1379953	1.535309e-02	0.45711275
43	5 - 3 - 1	0.001322451	0.008005211	0.028013932	21.1833401	4.289896e-05	0.02871810
44	5 - 3 - 2	0.165961482	0.174858085	0.115657645	0.6968945	2.792761e-02	0.48036269
45	5 - 3 - 3	0.832716167	0.817136714	0.120542842	0.1447586	5.132671e-01	0.96779250

```
46  6 - 1 - 1 0.837647500 0.825560468 0.150867220   0.1801082 4.079737e-01 0.97757900
47  6 - 1 - 2 0.160107570 0.167507322 0.147098981   0.9187509 1.781714e-02 0.56662877
48  6 - 1 - 3 0.002245003 0.006932206 0.033235286  14.8041188 7.380226e-06 0.03421411
49  6 - 2 - 1 0.114179020 0.148952764 0.104075338   0.9115102 2.175740e-02 0.38381868
50  6 - 2 - 2 0.786978667 0.729729595 0.168140872   0.2136537 2.691750e-01 0.92942210
51  6 - 2 - 3 0.098842144 0.121317632 0.114503248   1.1584456 1.172643e-02 0.44697534
52  6 - 3 - 1 0.001487237 0.008232219 0.026495147  17.8150180 4.924808e-05 0.03869840
53  6 - 3 - 2 0.175610207 0.174528112 0.104119405   0.5929006 2.426962e-02 0.41338935
54  6 - 3 - 3 0.822902233 0.817239667 0.107254263   0.1303366 5.748555e-01 0.96903936
55  7 - 1 - 1 0.844123500 0.843752429 0.114497720   0.1356410 5.789266e-01 0.97471700
56  7 - 1 - 2 0.153662120 0.150784927 0.113602354   0.7392997 2.187496e-02 0.41015764
57  7 - 1 - 3 0.002214117 0.005462640 0.009075922   4.0991158 5.477537e-06 0.02345761
58  7 - 2 - 1 0.102319653 0.145434259 0.107725900   1.0528368 2.280908e-02 0.40128670
59  7 - 2 - 2 0.798281833 0.736444911 0.161755698   0.2026298 3.124014e-01 0.92022197
60  7 - 2 - 3 0.099398652 0.118120826 0.104324915   1.0495607 1.385931e-02 0.40634395
61  7 - 3 - 1 0.001373821 0.009553671 0.047076211  34.2666156 3.853882e-05 0.02857105
62  7 - 3 - 2 0.163432494 0.162787465 0.102749102   0.6286945 2.684761e-02 0.41249333
63  7 - 3 - 3 0.835193300 0.827658854 0.111854658   0.1339267 5.530000e-01 0.96918863
64  8 - 1 - 1 0.852767500 0.831333895 0.152496197   0.1788251 3.585918e-01 0.98300150
65  8 - 1 - 2 0.144710545 0.154482768 0.136653943   0.9443261 1.336041e-02 0.51887439
66  8 - 1 - 3 0.002522037 0.014183340 0.065750150  26.0702554 7.674745e-06 0.07455803
67  8 - 2 - 1 0.083600687 0.140383955 0.117463964   1.4050598 1.888492e-02 0.39255398
68  8 - 2 - 2 0.822792333 0.741008940 0.181768351   0.2209164 2.729222e-01 0.93887567
69  8 - 2 - 3 0.093606782 0.118607100 0.117209582   1.2521484 1.147236e-02 0.43067540
70  8 - 3 - 1 0.001254936 0.006797639 0.020074132  15.9961379 1.945618e-05 0.02811231
71  8 - 3 - 2 0.142892487 0.152740628 0.109743901   0.7680173 1.426007e-02 0.40745554
72  8 - 3 - 3 0.855852667 0.840461728 0.112065903   0.1309406 5.807145e-01 0.98139210
73  9 - 1 - 1 0.861227500 0.832994794 0.142884098   0.1659075 4.765165e-01 0.98199935
74  9 - 1 - 2 0.136421415 0.149096290 0.120820910   0.8856447 1.390114e-02 0.45388818
75  9 - 1 - 3 0.002351138 0.017908922 0.071503963  30.4124909 9.804549e-06 0.12915124
76  9 - 2 - 1 0.094165580 0.129141352 0.092748068   0.9849466 1.568030e-02 0.33566208
77  9 - 2 - 2 0.812675567 0.739514950 0.182870602   0.2250229 2.656587e-01 0.93519110
78  9 - 2 - 3 0.093159383 0.131343683 0.141886906   1.5230554 1.138196e-02 0.51195437
79  9 - 3 - 1 0.001271442 0.006721652 0.015350584  12.0733632 1.906175e-05 0.03509135
80  9 - 3 - 2 0.143526060 0.141133985 0.094991426   0.6618410 1.823332e-02 0.34915251
81  9 - 3 - 3 0.855202467 0.852144366 0.098500475   0.1151780 6.399307e-01 0.97888960


Overall CV on movement
0.042292


=====================================================================
GROWTH PARAMETER FITS
=====================================================================
  parameter observed  expected      RMSE         CV    LR2.5   UP97.5
1  mu_Alpha     5.47 5.4165525 0.1009326 0.01845202 5.251950 5.585910
2   mu_Beta     2.89 2.8806925 2.5906349 0.89641345 2.738680 3.045780
3     theta     1.00 0.9810286 4.4890876 4.48908758 0.890993 1.000000
4     omega     0.80 0.8008810 4.6691263 5.83640782 0.784442 0.817117
```

c. Design scenario: 90% examination of commercial catch; 15000 tags released

```
Mean number of tags released
  stratum     Tags     Cost
1       1 2538.651 39158.95
2       2 1743.336 27295.76
3       3 1214.838 16535.51
4       4 2214.260 29924.28
5       5 3916.620 52965.11
6       6 2308.558 36250.92
7       7 1452.891 23335.92
8       8 1028.424 16580.77
      tot     Tags     Cost
1 Total   16417.58 242047.2

Mean number of fish examined
  stratum Fishexam     Cost
1       1 659470.9 606429.5
2       2 659351.9 605992.0
3       3 677147.4 248321.5
4       4 677409.0 248441.0
5       5 676987.7 248690.0
```

```
6       6 484389.6 248866.0
7       7 484744.2 248976.5
8       8 484484.3 248633.0
       tot    exam    Cost
1 Total    4803985 2704350

Mean number of tags recovered
  stratum      Tags
1       1  88.72618
2       2  91.78837
3       3 100.79238
4       4 102.22267
5       5 104.29689
6       6  68.89669
7       7  70.66700
8       8  73.55266
       tot     tags
1 Total    700.9428

================================================================
POPULATION FITS
================================================================

BY STRATUM & LENGTH

Total fits by length bin

   Numbers
```

	stock	stratum	length_bin	true_pop	exp_pop	RMSE	CV	LR2.5	UP97.5	bias
1	1	1	1	9819394.0	6580497.6	16440563.2	1.6742951	94454.50	24090260	0.6701531
2	1	1	2	1858781.0	1840318.4	1280944.9	0.6891317	86315.97	4894620	0.9900674
3	1	1	3	2720390.0	2652372.9	1461412.1	0.5372068	221898.88	5783067	0.9749973
4	1	1	4	853898.0	922646.2	786232.9	0.9207574	45772.75	2841258	1.0805110
5	1	1	5	1432697.0	1445242.6	1077861.1	0.7523301	71327.75	3798936	1.0087566
6	1	1	6	1027808.0	1141547.3	974135.1	0.9477793	57950.64	3708967	1.1106620
7	1	1	7	1848468.0	1690304.2	1227566.7	0.6640995	96365.20	4474240	0.9144352
8	1	1	8	971744.0	830713.1	770807.0	0.7932203	46560.00	2574146	0.8548683
9	1	1	9	1038509.6	844773.4	657213.7	0.6328432	44480.45	2171600	0.8134479
10	1	2	1	7148476.0	6783330.9	9683762.0	1.3546610	245994.60	24616042	0.9489199
11	1	2	2	1442488.0	2365111.3	1799617.8	1.2475791	276894.65	6144985	1.6396055
12	1	2	3	1932185.0	3219769.0	2179070.2	1.1277751	589110.69	7209853	1.6663875
13	1	2	4	527582.0	1090842.0	1006996.4	1.9087012	117891.47	3222396	2.0676255
14	1	2	5	848039.0	1789019.7	1565863.1	1.8464518	176649.43	4887197	2.1095960
15	1	2	6	662626.0	1494737.9	1486466.8	2.2432968	163598.15	4191506	2.2557792
16	1	2	7	847296.2	2097815.9	1953324.0	2.3053614	245480.41	5418761	2.4758944
17	1	2	8	322543.0	1017251.5	1058248.3	3.2809526	96286.89	2985076	3.1538476
18	1	2	9	397475.0	863861.3	846445.1	2.1295556	74297.52	2465702	2.1733726
19	2	3	1	4111469.0	3997613.3	5679586.8	1.3814009	179304.79	15693236	0.9723078
20	2	3	2	680678.0	1706890.9	1999468.7	2.9374664	132248.15	5958230	2.5076334
21	2	3	3	1011278.0	2096509.2	2144451.9	2.1205365	197541.77	6825644	2.0731284
22	2	3	4	375713.0	691234.2	773716.4	2.0593282	54559.27	2563935	1.8397933
23	2	3	5	733105.0	1188324.6	1108198.8	1.5116509	108625.00	3780572	1.6209473
24	2	3	6	615578.0	1048657.5	980423.1	1.5926870	79686.16	3314644	1.7035331
25	2	3	7	928584.0	1537186.7	1364780.1	1.4697433	152662.01	4712162	1.6554094
26	2	3	8	419288.5	790462.8	897396.2	2.1402834	64778.06	3090332	1.8852480
27	2	3	9	416626.9	678385.6	696567.4	1.6719215	60966.17	2354114	1.6282810
28	2	4	1	8545756.0	4087238.1	6817644.5	0.7977813	151471.59	17737116	0.4782769
29	2	4	2	1626135.0	1467094.6	1375942.7	0.8461430	104590.88	5003758	0.9021973
30	2	4	3	2285581.0	1917717.9	1548604.7	0.6775541	174984.03	5557901	0.8390505
31	2	4	4	686659.0	546603.0	582934.0	0.8489425	38594.18	2137672	0.7960326
32	2	4	5	1183629.0	917671.8	879802.8	0.7433096	75764.59	2968326	0.7753036
33	2	4	6	982014.0	763545.5	768718.8	0.7827983	56875.98	2706477	0.7775302
34	2	4	7	1416729.0	1100095.2	1089924.0	0.7693243	80443.59	3698243	0.7765036
35	2	4	8	837158.0	609904.2	682837.3	0.8156612	40687.52	2158002	0.7285414
36	2	4	9	882732.6	664316.8	699676.5	0.7926256	33845.93	2252106	0.7525686
37	2	5	1	17152130.0	8616359.0	11666746.6	0.6801923	255819.57	25736392	0.5023492
38	2	5	2	3592000.0	3457908.2	2243929.6	0.6247020	327862.31	8507755	0.9626693
39	2	5	3	4465180.0	4298937.6	2232775.0	0.5000414	508105.86	9423704	0.9627692
40	2	5	4	1188960.0	1244910.4	864768.0	0.7273315	93727.24	3285210	1.0470582
41	2	5	5	1920851.0	2026622.7	1256267.7	0.6540162	218624.08	5171729	1.0550650
42	2	5	6	1454071.0	1474767.4	1010206.9	0.6947438	140393.34	4134274	1.0142334
43	2	5	7	1856569.0	1974647.5	1191115.3	0.6415680	186758.09	4705800	1.0636004
44	2	5	8	792360.0	912048.3	711437.1	0.8978710	68959.58	2709223	1.1510530
45	2	5	9	930555.8	889339.1	713662.9	0.7669211	61382.13	2602889	0.9557075
46	3	6	1	9399611.0	7960867.8	32717329.7	3.4807110	120104.50	32128345	0.8469359
47	3	6	2	2008033.0	2140447.9	1725807.6	0.8594518	88950.56	6711454	1.0659426
48	3	6	3	2755678.0	2942456.0	1960615.9	0.7114822	272284.27	7503411	1.0677793
49	3	6	4	726580.0	871776.8	887221.1	1.2210922	46052.44	3092680	1.1998360
50	3	6	5	1159637.0	1366206.6	1163898.7	1.0036750	83541.51	4340093	1.1781330
51	3	6	6	816555.0	1008543.5	1048768.6	1.2843820	53960.26	3651925	1.2351201
52	3	6	7	1229585.0	1351218.0	1081866.9	0.8798634	94595.13	4035897	1.0989220

53	3	6	8	560148.0	620262.4	736125.3	1.3141621	35959.59	2518569	1.1073188
54	3	6	9	576602.8	533823.3	642277.4	1.1138991	32056.50	1882409	0.9258076
55	3	7	1	5882663.0	4986374.7	11020258.3	1.8733452	96126.95	30978809	0.8476390
56	3	7	2	1126338.0	869810.1	755786.1	0.6710119	44766.51	2524579	0.7722460
57	3	7	3	1453034.0	1144410.5	839646.1	0.5778572	78318.70	2979651	0.7876006
58	3	7	4	419144.0	456117.6	780500.8	1.8621305	23750.31	1846102	1.0882122
59	3	7	5	709752.0	626524.8	675187.2	0.9513001	36791.40	2105603	0.8827376
60	3	7	6	458265.0	484726.5	548920.8	1.1978240	25567.72	1861124	1.0577427
61	3	7	7	547681.4	583616.6	612586.8	1.1185093	38527.60	2033252	1.0656133
62	3	7	8	334529.7	450317.9	600734.3	1.7957577	23747.92	1987168	1.3461223
63	3	7	9	501208.9	628636.1	1529972.4	3.0525644	26501.91	2734715	1.2542398
64	3	8	1	3466915.0	13360791.8	64560741.4	18.6219568	78439.67	96412731	3.8537985
65	3	8	2	631414.0	678210.7	458593.1	0.7262955	84145.07	1787901	1.0741141
66	3	8	3	835650.0	837795.5	377710.0	0.4519955	256621.24	1945136	1.0025675
67	3	8	4	250608.0	378131.6	518501.3	2.0689734	33358.99	1469254	1.5088569
68	3	8	5	399780.0	510283.4	390499.5	0.9767861	54345.62	1408568	1.2764106
69	3	8	6	341815.0	500049.3	1038217.7	3.0373673	45832.17	1806768	1.4629239
70	3	8	7	597344.9	707282.4	575849.7	0.9640154	95076.41	2059000	1.1840435
71	3	8	8	396272.7	779399.2	2264504.7	5.7145110	45462.74	3319615	1.9668255
72	3	8	9	865307.8	2132245.2	5551104.5	6.4151795	59933.94	14141312	2.4641466

	biomass									
	stock	stratum	length_bin	true_bio	exp_bio	RMSE_bio	CV_bio	LR2.5	UP97.5	bias
2	1	1	2	704.7022	698.3368	486.0647	0.6897448	32.7	1857.3	0.9909673
3	1	1	3	1342.9958	1299.2857	716.4358	0.5334609	108.7	2832.1	0.9674532
4	1	1	4	509.3562	550.3637	468.9926	0.9207557	27.3	1694.8	1.0805084
5	1	1	5	977.2646	985.4784	734.9547	0.7520529	48.6	2590.3	1.0084049
6	1	1	6	831.0901	924.6839	789.1987	0.9495946	46.9	3004.3	1.1126156
7	1	1	7	1961.7952	1783.8785	1297.3033	0.6612838	101.8	4716.8	0.9093092
8	1	1	8	1473.8963	1254.6434	1164.9033	0.7903564	70.2	3887.9	0.8512427
9	1	1	9	3090.5890	2225.1942	1868.7455	0.6046567	117.6	5767.5	0.7199903
11	1	2	2	546.1504	897.4957	683.5519	1.2515817	105.0	2330.7	1.6433123
12	1	2	3	949.1864	1577.2845	1065.9096	1.1229718	288.4	3529.6	1.6617226
13	1	2	4	314.7064	650.6951	600.6800	1.9086997	70.3	1922.2	2.0676258
14	1	2	5	578.4150	1219.8693	1067.6005	1.8457345	120.5	3333.7	2.1089863
15	1	2	6	536.2641	1210.7855	1204.3930	2.2458953	132.5	3395.1	2.2578155
16	1	2	7	877.9498	2213.7024	2071.4652	2.3594348	259.9	5725.7	2.5214454
17	1	2	8	490.2926	1536.3721	1596.3939	3.2560021	145.6	4515.4	3.1335819
18	1	2	9	1223.0119	2275.0502	2133.0771	1.7441181	196.1	6533.4	1.8602028
20	2	3	2	257.9074	648.2354	759.6540	2.9454529	50.3	2262.1	2.5134428
21	2	3	3	500.8869	1028.1289	1049.1637	2.0946118	96.9	3348.6	2.0526167
22	2	3	4	224.1155	412.3258	461.5276	2.0593295	32.5	1529.4	1.8397917
23	2	3	5	500.9594	810.2445	755.1536	1.5074147	74.0	2577.5	1.6173856
24	2	3	6	498.4988	849.0491	793.7589	1.5922984	64.5	2683.6	1.7032119
25	2	3	7	973.0501	1611.4799	1430.8441	1.4704732	159.8	4945.7	1.6561120
26	2	3	8	628.6183	1195.8493	1359.8402	2.1632206	98.1	4674.7	1.9023456
27	2	3	9	1330.7216	1810.1391	1788.8014	1.3442342	161.9	6288.2	1.3602689
29	2	4	2	617.2185	557.1825	522.5324	0.8465923	39.7	1901.0	0.9027315
30	2	4	3	1123.7044	940.4084	760.1752	0.6764903	85.8	2727.1	0.8368824
31	2	4	4	409.5970	326.0518	347.7251	0.8489446	23.0	1275.1	0.7960307
32	2	4	5	807.8594	625.7061	600.1459	0.7428842	51.7	2023.5	0.7745235
33	2	4	6	795.8706	618.1952	622.6073	0.7822972	46.0	2191.5	0.7767534
34	2	4	7	1485.0560	1153.1900	1142.3719	0.7692450	84.3	3878.8	0.7765296
35	2	4	8	1270.8213	922.6322	1034.5060	0.8140452	61.6	3259.4	0.7260125
36	2	4	9	2520.8990	1773.6869	1923.4087	0.7629852	90.3	5957.8	0.7035930
38	2	5	2	1361.1085	1313.2481	851.9735	0.6259410	124.5	3231.4	0.9648372
39	2	5	3	2188.2372	2108.0937	1094.8594	0.5003386	248.9	4620.5	0.9633753
40	2	5	4	709.2231	742.5972	515.8412	0.7273328	55.9	1959.7	1.0470573
41	2	5	5	1311.2956	1381.8281	856.4303	0.6531176	149.1	3525.2	1.0537884
42	2	5	6	1176.7196	1194.0485	817.8959	0.6950644	113.7	3346.7	1.0147265
43	2	5	7	1937.3720	2070.0554	1249.5309	0.6449618	196.1	4935.8	1.0684863
44	2	5	8	1187.4878	1379.7101	1078.0745	0.9078615	104.4	4095.8	1.1618731
45	2	5	9	3263.9906	2372.9040	2100.1343	0.6434253	161.9	6994.8	0.7269947
47	3	6	2	761.2854	811.9123	654.7193	0.8600181	33.7	2545.0	1.0665019
48	3	6	3	1352.8026	1440.8366	959.7538	0.7094559	133.2	3673.9	1.0650753
49	3	6	4	433.4101	520.0203	529.2347	1.2210946	27.5	1844.8	1.1998341
50	3	6	5	790.4542	931.1934	793.3285	1.0036363	56.9	2957.6	1.1780485
51	3	6	6	660.4672	816.5913	849.2430	1.2858216	43.7	2958.0	1.2363843
52	3	6	7	1291.9545	1418.1893	1135.5298	0.8789239	99.5	4237.6	1.0977084
53	3	6	8	838.3143	934.8788	1109.8215	1.3238728	54.1	3793.5	1.1151889
54	3	6	9	2050.4870	1445.6161	1837.8112	0.8962803	87.0	5074.4	0.7050111
56	3	7	2	426.2993	329.9205	286.3520	0.6717159	17.0	958.0	0.7739174
57	3	7	3	713.8823	560.3762	412.0169	0.5771497	38.4	1455.8	0.7849701
58	3	7	4	250.0224	272.0779	465.5752	1.8621341	14.2	1101.2	1.0882144
59	3	7	5	483.7935	427.0333	460.2260	0.9512860	25.1	1435.4	0.8826768
60	3	7	6	369.9720	392.4742	444.4967	1.2014335	20.7	1506.3	1.0608216
61	3	7	7	575.7413	612.5277	642.9677	1.1167649	40.4	2135.2	1.0638940
62	3	7	8	512.7729	678.8221	903.8065	1.7625864	35.8	3009.3	1.3238260

63	3	7	9	1661.4012	1701.8001	4118.7886	2.4791054	72.4	7416.3	1.0243162
65	3	8	2	239.2613	257.2459	173.9559	0.7270541	31.9	678.5	1.0751675
66	3	8	3	411.2117	410.2356	184.9521	0.4497735	125.6	950.7	0.9976263
67	3	8	4	149.4895	225.5573	309.2891	2.0689697	19.9	876.4	1.5088508
68	3	8	5	273.0141	347.7995	265.9963	0.9742951	37.0	959.7	1.2739249
69	3	8	6	277.1222	404.8745	840.5520	3.0331455	37.1	1462.6	1.4609963
70	3	8	7	628.7998	742.2364	603.9799	0.9605281	99.9	2161.6	1.1804018
71	3	8	8	606.2867	1174.8675	3411.9412	5.6276039	68.5	5002.3	1.9378086
72	3	8	9	2830.4974	5775.1921	14921.1480	5.2715639	163.8	38246.6	2.0403453

BY STOCK & LENGTH

Total fits by length bin

numbers

	stock	length_bin	true_pop	exp_pop	RMSE	CV	bias
1	1	1	16967870	13363829	19080549	1.1245106	0.7875961
4	1	2	3301269	4205430	2208946	0.6691204	1.2738828
7	1	3	4652575	5872142	2623752	0.5639354	1.2621273
10	1	4	1381480	2013488	1277577	0.9247889	1.4574863
13	1	5	2280736	3234262	1900977	0.8334926	1.4180783
16	1	6	1690434	2636285	1777223	1.0513414	1.5595316
19	1	7	2695764	3788120	2307032	0.8557987	1.4052120
22	1	8	1294287	1847965	1309211	1.0115305	1.4277858
25	1	9	1435985	1708635	1071634	0.7462712	1.1898699
2	2	1	29809355	16701210	14657795	0.4917180	0.5602674
5	2	2	5898813	6631894	3305497	0.5603665	1.1242760
8	2	3	7762039	8313165	3461522	0.4459552	1.0710027
11	2	4	2251332	2482748	1298566	0.5767988	1.1027905
14	2	5	3837585	4132619	1892186	0.4930667	1.0768801
17	2	6	3051663	3286970	1603956	0.5256007	1.0771080
20	2	7	4201882	4611929	2114075	0.5031258	1.0975866
23	2	8	2048807	2312415	1333315	0.6507765	1.1286646
26	2	9	2229915	2232042	1218223	0.5463093	1.0009535
3	3	1	18749189	26308034	73211741	3.9047951	1.4031559
6	3	2	3765785	3688469	1939054	0.5149137	0.9794687
9	3	3	5044362	4924662	2166030	0.4293962	0.9762705
12	3	4	1396332	1706026	1290421	0.9241506	1.2217911
15	3	5	2269169	2503015	1401081	0.6174423	1.1030535
18	3	6	1616635	1993319	1574524	0.9739514	1.2330052
21	3	7	2374611	2642117	1370146	0.5769982	1.1126524
24	3	8	1290950	1849980	2455757	1.9022863	1.4330369
27	3	9	1943119	3294705	5793798	2.9816994	1.6955749

biomass

	stock	length_bin	true_bio	exp_bio	RMSE	CV	bias
1	1	2	1250.8526	1595.832	838.7503	0.6705429	1.2757958
4	1	3	2292.1822	2876.570	1284.3066	0.5602986	1.2549483
7	1	4	824.0626	1201.059	762.0830	0.9247878	1.4574848
10	1	5	1555.6796	2205.348	1296.1209	0.8331541	1.4176105
13	1	6	1367.3543	2135.469	1439.9296	1.0530772	1.5617528
16	1	7	2839.7450	3997.581	2444.1694	0.8607003	1.4077253
19	1	8	1964.1889	2791.016	1976.2270	1.0061288	1.4209507
22	1	9	4313.6008	4500.244	2835.8822	0.6574280	1.0432686
2	2	2	2236.2343	2518.666	1255.3777	0.5613802	1.1262979
5	2	3	3812.8285	4076.631	1696.2688	0.4448846	1.0691881
8	2	4	1342.9355	1480.975	774.6048	0.5767997	1.1027892
11	2	5	2620.1145	2817.779	1289.9244	0.4923160	1.0754411
14	2	6	2471.0890	2661.293	1298.7096	0.5255616	1.0769717
17	2	7	4395.4781	4834.725	2216.6767	0.5043085	1.0999316
20	2	8	3086.9274	3498.192	2020.3001	0.6544696	1.1332277
23	2	9	7115.6112	5956.730	3363.0159	0.4726250	0.8371354
3	3	2	1426.8460	1399.079	735.4696	0.5154512	0.9805394
6	3	3	2477.8967	2411.448	1060.7038	0.4280662	0.9731836
9	3	4	832.9220	1017.655	769.7463	0.9241518	1.2217897
12	3	5	1547.2618	1706.026	954.9514	0.6171880	1.1026099
15	3	6	1307.5613	1613.940	1274.8798	0.9750058	1.2343130
18	3	7	2496.4956	2772.953	1437.9245	0.5759772	1.1107383
21	3	8	1957.3738	2788.568	3699.9882	1.8902818	1.4246478
24	3	9	6542.3856	8922.608	15587.9001	2.3826019	1.3638157

STRATUM FITS +25cm

numbers

stratum	true_pop	exp_pop	RMSE	CV	bias
1	11752296	11367918	3006397	0.2558136	0.9672934
2	6980234	13938409	4394810	0.6296079	1.9968397
3	5180851	9737652	3812830	0.7359466	1.8795466
4	9900638	7986949	2853057	0.2881691	0.8067106
5	16200547	16279181	3975081	0.2453671	1.0048538
6	9832819	10834735	3491275	0.3550635	1.1018951
7	5549953	5244160	2391558	0.4309151	0.9449017
8	4318192	6523397	6174670	1.4299201	1.5106778

biomass

stratum	true_bio	exp_bio	RMSE	CV	bias
1	10891.689	9721.865	2943.585	0.2702597	0.8925947
2	5515.977	11581.255	3992.996	0.7238964	2.0995837
3	4914.758	8365.452	3191.775	0.6494267	1.7021087
4	9031.026	6917.053	2791.837	0.3091384	0.7659211
5	13135.434	12562.485	3275.245	0.2493443	0.9563814
6	8179.175	8319.238	2979.788	0.3643140	1.0171243
7	4993.885	4975.032	4367.218	0.8745132	0.9962248
8	5415.683	9338.009	15348.752	2.8341307	1.7242533

STOCK FITS +25cm

numbers

stock	true_pop	exp_pop	RMSE	CV	bias
1	18732530	25306327	5324733	0.2842506	1.350929
2	31282036	34003782	6203134	0.1982970	1.087007
3	19700964	22602292	7485660	0.3799641	1.147268

biomass

stock	true_bio	exp_bio	RMSE	CV	bias
1	16407.67	21303.12	4960.716	0.3023414	1.298364
2	27081.22	27844.99	5358.079	0.1978522	1.028203
3	18588.74	22632.28	16233.790	0.8733130	1.217526

SNA 1 FITS (25 cm +)

numbers

true_pop	exp_pop	RMSE	CV	bias
69715530	81912401	11084528	0.1589965	1.174952

biomass

true_bio	exp_bio	RMSE	CV	bias
62077.63	71780.39	17800.38	0.2867439	1.1563

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TAG RECOVERY FITS

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release	recovery	TagObs	TagExp	RMSE	CV
1	1	60.055165496	61.32643740	2.91215886	0.04849140
1	2	32.344032096	29.12092029	5.23553052	0.16187006
1	3	11.560682046	11.52142582	2.43398297	0.21053974
1	4	1.206619860	1.54535879	0.95722328	0.79330973
1	5	0.169508526	0.29664500	0.40332617	2.37938572
1	6	0.045135406	0.13804369	0.27414853	6.07391300
1	7	0.010030090	0.03615419	0.10388193	10.35702804
1	8	0.000000000	0.02899584	0.12558294	Inf
2	1	22.069207623	23.18678768	3.99343752	0.18095065
2	2	37.430290873	36.36233183	3.53112772	0.09433877
2	3	22.391173521	19.51102083	4.71940143	0.21077062
2	4	3.652958877	4.33370085	1.77141965	0.48492735
2	5	0.802407222	1.04919085	0.84838799	1.05730353
2	6	0.181544634	0.33332840	0.43499904	2.39609967
2	7	0.044132397	0.38534912	0.45035435	10.20462008
2	8	0.014042126	0.10256603	0.16073792	11.44683644

17	3	1	5.245737212	7.10690465	2.85683613	0.54460146
18	3	2	15.205616851	14.95729958	3.45983569	0.22753669
19	3	3	27.500501505	29.79768362	3.72334302	0.13539182
20	3	4	12.745235707	15.60858084	4.22043198	0.33113801
21	3	5	3.611835507	5.38024498	2.61809404	0.72486525
22	3	6	0.874623872	1.37464940	1.02763026	1.17493964
23	3	7	0.245737212	0.46026884	0.50745399	2.06502705
24	3	8	0.049147442	0.27197768	0.34554158	7.03071343
25	4	1	1.045135406	1.14512463	0.84571816	0.80919483
26	4	2	4.691073220	3.96091412	1.82994611	0.39009114
27	4	3	23.944834504	18.85651593	6.08213978	0.25400634
28	4	4	42.965897693	43.56926637	2.72168374	0.06334521
29	4	5	18.106318957	17.79285843	3.66177966	0.20223766
30	4	6	4.637913741	5.05245287	1.88240827	0.40587393
31	4	7	1.381143430	1.60310746	0.96191084	0.69645977
32	4	8	0.317953862	0.96240671	0.85635913	2.69334401
33	5	1	0.266800401	0.39456365	0.46552654	1.74484946
34	5	2	1.740220662	1.68787291	0.99680807	0.57280556
35	5	3	12.298896690	11.50907471	2.58799429	0.21042491
36	5	4	32.773319960	31.55871670	4.14927885	0.12660539
37	5	5	60.462387161	60.74979139	3.44713722	0.05701292
38	5	6	20.017051153	20.10958269	3.29284631	0.16450207
39	5	7	6.386158475	6.72185154	1.84693979	0.28920983
40	5	8	1.424272818	1.81105578	1.04925899	0.73669804
41	6	1	0.035105316	0.14191095	0.26793907	7.63243593
42	6	2	0.321965898	0.43136452	0.49128220	1.52588273
43	6	3	2.576730191	2.38047691	1.16124556	0.45066634
44	6	4	7.320962889	7.28501842	2.01154074	0.27476450
45	6	5	17.411233701	16.57158173	3.46658184	0.19910030
46	6	6	32.374122367	31.79888479	2.73680082	0.08453668
47	6	7	14.575727182	14.34315088	2.67138335	0.18327616
48	6	8	3.617853561	3.77665908	1.35337795	0.37408312
49	7	1	0.007021063	0.02181650	0.08706072	12.39993441
50	7	2	0.051153460	0.31641452	0.38060249	7.44040545
51	7	3	0.461384152	0.48698390	0.52749886	1.14329645
52	7	4	1.351053159	1.43673604	0.97160279	0.71914475
53	7	5	3.204613842	3.44319752	1.52840608	0.47693924
54	7	6	9.152457372	9.01311600	2.47558000	0.27048255
55	7	7	37.182547643	37.68013336	1.88714969	0.05075364
56	7	8	15.960882648	15.65180953	2.83696775	0.17774504
57	8	1	0.002006018	0.01201160	0.06430653	32.05680382
58	8	2	0.004012036	0.05804565	0.10109413	25.19771077
59	8	3	0.058174524	0.19761314	0.28523914	4.90316253
60	8	4	0.206619860	0.59278666	0.59485807	2.87899757
61	8	5	0.528585757	0.63580194	0.67827603	1.28319014
62	8	6	1.613841525	1.64885616	1.08449210	0.67199417
63	8	7	10.841524574	10.93672926	2.58264532	0.23821791
64	8	8	52.168505517	49.99991590	2.83059506	0.05425870

	rec_stra	Length_bin	TagObs	TagExp	RMSE	CV
1	1	1	4.077232	4.440847	1.1982409	0.29388590
2	1	2	13.898696	14.653067	2.1870991	0.15736002
3	1	3	23.058175	24.366480	2.9794796	0.12921576
4	1	4	5.580742	5.963961	1.4154117	0.25362427
5	1	5	9.923771	10.261995	1.7311869	0.17444849
6	1	6	6.507523	6.816291	1.3581684	0.20870744
7	1	7	10.351053	10.709042	1.7482158	0.16889255
8	1	8	6.278837	6.627246	1.4430539	0.22982823
9	1	9	9.050150	9.496630	1.8165060	0.20071556
10	2	1	4.735206	4.410953	1.4888801	0.31442775
11	2	2	13.997994	13.466137	2.5585833	0.18278214
12	2	3	23.734203	22.673704	3.5471123	0.14945150
13	2	4	6.012036	5.642454	1.7308892	0.28790399
14	2	5	9.981946	9.502700	2.1931456	0.21971123
15	2	6	6.738215	6.274839	1.7521275	0.26002845
16	2	7	10.743230	10.060139	2.2913648	0.21328454
17	2	8	6.466399	6.094719	1.8185974	0.28123804
18	2	9	9.379137	8.769519	2.1995789	0.23451825
19	3	1	5.496489	5.100744	1.6680882	0.30348248
20	3	2	13.996991	12.841262	3.0858090	0.22046231
21	3	3	26.344032	24.384884	4.2011059	0.15947088
22	3	4	7.713139	7.126571	2.0480868	0.26553219
23	3	5	12.496489	11.767154	2.3802724	0.19047528
24	3	6	8.398195	7.951859	2.0263092	0.24127914
25	3	7	11.880642	11.386111	2.4234004	0.20397891
26	3	8	6.818455	6.315609	1.8787857	0.27554418

27	3	9	7.647944	7.386601	1.9725457	0.25791844
28	4	1	6.096289	6.035011	1.6393734	0.26891335
29	4	2	13.248746	13.552258	2.5208366	0.19026982
30	4	3	25.966901	26.692663	3.4031374	0.13105674
31	4	4	7.895687	8.184215	1.9053312	0.24131291
32	4	5	13.064193	13.571078	2.4378298	0.18660394
33	4	6	9.157472	9.500107	2.0200727	0.22059282
34	4	7	13.096289	13.793852	2.4540295	0.18738358
35	4	8	6.739218	7.160954	1.7273378	0.25631133
36	4	9	6.957874	7.440026	1.8802718	0.27023656
37	5	1	5.173521	5.332798	1.4679272	0.28373854
38	5	2	12.279840	12.543719	2.5008737	0.20365687
39	5	3	24.383149	25.190885	3.4254235	0.14048322
40	5	4	7.748245	7.772644	1.8040102	0.23282824
41	5	5	13.109328	13.348497	2.3322798	0.17790994
42	5	6	9.664995	9.805167	1.9972304	0.20664577
43	5	7	14.970913	15.022828	2.3724564	0.15847106
44	5	8	8.197593	8.197969	1.7623067	0.21497856
45	5	9	8.769308	8.704806	1.8822960	0.21464590
46	6	1	3.218656	3.359783	1.2665685	0.39350849
47	6	2	9.581745	9.626639	2.1661558	0.22607111
48	6	3	17.756269	17.632331	2.9405935	0.16560875
49	6	4	4.500502	4.722851	1.5402157	0.34223201
50	6	5	8.023069	8.087255	1.9583375	0.24408832
51	6	6	5.739218	5.800079	1.6929754	0.29498365
52	6	7	8.930792	9.125211	2.0779082	0.23266784
53	6	8	4.946841	5.016616	1.4705172	0.29726392
54	6	9	6.199599	6.098150	1.5635993	0.25220976
55	7	1	2.513541	2.626705	1.0484902	0.41713676
56	7	2	10.875627	11.292110	2.1190358	0.19484263
57	7	3	19.825476	20.551850	2.9492084	0.14875851
58	7	4	4.672016	4.818925	1.3730833	0.29389525
59	7	5	8.310933	8.594835	1.8368881	0.22102069
60	7	6	5.925777	5.987482	1.5338501	0.25884370
61	7	7	9.646941	9.574383	2.0368554	0.21114003
62	7	8	4.565697	4.495247	1.3023767	0.28525254
63	7	9	4.330993	4.225207	1.2419224	0.28675234
64	8	1	2.573721	2.525562	0.8614615	0.33471440
65	8	2	12.784353	12.661942	1.5232744	0.11915146
66	8	3	23.557673	23.142402	2.1901905	0.09297143
67	8	4	5.193581	5.025399	1.0428145	0.20078913
68	8	5	9.204614	8.947749	1.3302260	0.14451731
69	8	6	5.804413	5.759766	1.1001761	0.18954132
70	8	7	8.433300	8.355489	1.4217424	0.16858672
71	8	8	3.562688	3.601144	0.9083393	0.25495899
72	8	9	2.438315	2.585935	0.9170883	0.37611561

	TagObs	TagExp	RMSE	CV
1	700.9428	700.582	17.40619	0.02483255

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PROPORTIONAL MOVEMENT FITS
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	Lb__Fr__To	true_mm	geo_obs	RMSE	CV	LR2.5	UP97.5
1	1 - 1 - 1	0.858749000	0.805616384	0.212597628	0.24756667	4.591519e-02	0.98190850
2	1 - 1 - 2	0.139050975	0.158763536	0.157639342	1.13368024	1.388238e-02	0.62689410
3	1 - 1 - 3	0.002199921	0.035620065	0.146727348	66.69663499	1.766753e-06	0.61632179
4	1 - 2 - 1	0.150323860	0.169584752	0.127543036	0.84845503	1.362515e-02	0.48111065
5	1 - 2 - 2	0.738555933	0.672113048	0.221366545	0.29972888	9.763547e-02	0.93560633
6	1 - 2 - 3	0.111120437	0.158302194	0.171246594	1.54108999	9.230533e-03	0.61959738
7	1 - 3 - 1	0.001321854	0.016470729	0.088632729	67.05182457	4.584650e-06	0.04517514
8	1 - 3 - 2	0.177218823	0.173174956	0.127654677	0.72032234	1.248772e-02	0.48213173
9	1 - 3 - 3	0.821458933	0.810354319	0.147693494	0.17979413	4.423673e-01	0.98074271
10	2 - 1 - 1	0.863663500	0.819405276	0.147056150	0.17027019	4.444204e-01	0.96855600
11	2 - 1 - 2	0.134116670	0.175942741	0.145534801	1.08513581	2.584965e-02	0.54074067
12	2 - 1 - 3	0.002220054	0.004651977	0.005414043	2.43869827	2.062967e-05	0.01769960
13	2 - 2 - 1	0.171122367	0.160963306	0.073275156	0.42820326	4.430212e-02	0.31268961
14	2 - 2 - 2	0.711572533	0.718229737	0.128076881	0.17999132	3.490870e-01	0.90093207
15	2 - 2 - 3	0.117304604	0.120806956	0.093618867	0.79808349	1.546281e-02	0.40568469
16	2 - 3 - 1	0.001286535	0.004830798	0.005493373	4.26989848	1.039901e-04	0.01716105
17	2 - 3 - 2	0.180456522	0.189504769	0.104218118	0.57752481	5.841912e-02	0.44025415

18	2 - 3 - 3	0.818257233	0.805664436	0.104691908	0.12794498	5.475426e-01	0.93418857
19	3 - 1 - 1	0.864165500	0.837336263	0.114777090	0.13281841	5.843511e-01	0.96784700
20	3 - 1 - 2	0.133691885	0.158376087	0.113642499	0.85003289	2.731698e-02	0.40638703
21	3 - 1 - 3	0.002142748	0.004287656	0.004676954	2.18268969	6.244545e-05	0.01396737
22	3 - 2 - 1	0.158601927	0.162533829	0.063035145	0.39744249	5.462002e-02	0.28951114
23	3 - 2 - 2	0.727094067	0.716535669	0.101631753	0.13977800	4.888803e-01	0.87133710
24	3 - 2 - 3	0.114303678	0.120930513	0.075107434	0.65708676	2.680335e-02	0.32420054
25	3 - 3 - 1	0.001250112	0.004631684	0.004929972	3.94362471	1.908469e-04	0.01288405
26	3 - 3 - 2	0.170413280	0.174377348	0.072507234	0.42547878	6.462827e-02	0.33107049
27	3 - 3 - 3	0.828336333	0.820990980	0.073401301	0.08861292	6.590192e-01	0.93288863
28	4 - 1 - 1	0.856559500	0.841344385	0.135593209	0.15829981	5.058395e-01	0.97581500
29	4 - 1 - 2	0.141295110	0.152647418	0.132694405	0.93912950	2.116573e-02	0.48442187
30	4 - 1 - 3	0.002145239	0.006008205	0.012420808	5.78994245	1.912944e-05	0.02840198
31	4 - 2 - 1	0.131129173	0.161289532	0.093757958	0.71500457	3.237546e-02	0.35680513
32	4 - 2 - 2	0.761521600	0.707976470	0.160500602	0.21076303	2.692870e-01	0.91253337
33	4 - 2 - 3	0.107349127	0.130734026	0.114725770	1.06871638	1.768678e-02	0.44858858
34	4 - 3 - 1	0.001289106	0.006351880	0.012380378	9.60384614	7.676495e-05	0.02539926
35	4 - 3 - 2	0.166752871	0.175724690	0.099556546	0.59703047	3.060478e-02	0.41271718
36	4 - 3 - 3	0.831958100	0.817923434	0.101280268	0.12173722	5.709569e-01	0.96155853
37	5 - 1 - 1	0.846992500	0.846398930	0.102149882	0.12060305	6.112470e-01	0.96725200
38	5 - 1 - 2	0.150806710	0.148677157	0.101253057	0.67140950	2.883780e-02	0.37860918
39	5 - 1 - 3	0.002200553	0.004923915	0.006812527	3.09582565	2.823021e-05	0.02244399
40	5 - 2 - 1	0.118294067	0.150618806	0.083038944	0.70197049	3.312491e-02	0.32394181
41	5 - 2 - 2	0.777935800	0.730900976	0.131663468	0.16924722	4.228495e-01	0.90133637
42	5 - 2 - 3	0.103770180	0.118480214	0.089641037	0.86384197	2.194540e-02	0.35809062
43	5 - 3 - 1	0.001322451	0.005269873	0.006880606	5.20291856	7.687494e-05	0.01883601
44	5 - 3 - 2	0.165961482	0.174508055	0.087837704	0.52926560	4.928378e-02	0.39260817
45	5 - 3 - 3	0.832716167	0.820222070	0.089257710	0.10718864	6.026256e-01	0.94680303
46	6 - 1 - 1	0.837647500	0.837638751	0.111197958	0.13275030	5.703130e-01	0.97367950
47	6 - 1 - 2	0.160107570	0.157647230	0.110284709	0.68881633	2.265166e-02	0.42004863
48	6 - 1 - 3	0.002245003	0.004714021	0.006928703	3.08627816	3.373325e-05	0.02089703
49	6 - 2 - 1	0.114179020	0.149951193	0.089892057	0.78729049	3.256082e-02	0.33045085
50	6 - 2 - 2	0.786978667	0.729475879	0.151077254	0.19197122	3.289433e-01	0.91230667
51	6 - 2 - 3	0.098842144	0.120572941	0.103444083	1.04655847	1.648740e-02	0.38996360
52	6 - 3 - 1	0.001487237	0.006075170	0.012036434	8.09315312	1.486090e-04	0.02182711
53	6 - 3 - 2	0.175610207	0.181110882	0.101319546	0.57695704	4.013426e-02	0.43889908
54	6 - 3 - 3	0.822902233	0.812813950	0.102755147	0.12486920	5.397845e-01	0.95211073
55	7 - 1 - 1	0.844123500	0.841977411	0.091254546	0.10810568	6.214780e-01	0.96294300
56	7 - 1 - 2	0.153662120	0.153930088	0.090406533	0.58834626	3.523864e-02	0.37387535
57	7 - 1 - 3	0.002214117	0.004092494	0.004849131	2.19009701	4.250988e-05	0.01592546
58	7 - 2 - 1	0.102319653	0.148932625	0.097731280	0.95515648	3.269928e-02	0.36477188
59	7 - 2 - 2	0.798281833	0.741622940	0.134722546	0.16876564	4.292927e-01	0.90663883
60	7 - 2 - 3	0.099398652	0.109444447	0.079115871	0.79594511	2.032578e-02	0.32207103
61	7 - 3 - 1	0.001373821	0.005576562	0.009584587	6.97658860	1.098664e-04	0.02054802
62	7 - 3 - 2	0.163432494	0.171127239	0.082230074	0.50314397	4.506214e-02	0.36141766
63	7 - 3 - 3	0.835193300	0.823296195	0.083116585	0.09951778	6.304745e-01	0.95095341
64	8 - 1 - 1	0.852767500	0.842087594	0.111418485	0.13065517	5.870583e-01	0.96968400
65	8 - 1 - 2	0.144710545	0.151971935	0.110046494	0.76045940	2.637600e-02	0.41191045
66	8 - 1 - 3	0.002522037	0.005940462	0.009105092	3.61021354	1.485126e-05	0.02859580
67	8 - 2 - 1	0.083600687	0.140241843	0.101745944	1.21704675	2.877016e-02	0.34716483
68	8 - 2 - 2	0.822792333	0.745835196	0.162534269	0.19753984	3.227965e-01	0.92638063
69	8 - 2 - 3	0.093606782	0.113922965	0.104871031	1.12033582	1.465248e-02	0.41568980
70	8 - 3 - 1	0.001254936	0.007093146	0.015691730	12.50400653	4.898839e-05	0.03261240
71	8 - 3 - 2	0.142892487	0.157937620	0.092212118	0.64532517	3.204770e-02	0.36949862
72	8 - 3 - 3	0.855852667	0.834969221	0.095145624	0.11117056	6.170911e-01	0.96368497
73	9 - 1 - 1	0.861227500	0.845847531	0.107355690	0.12465427	5.800150e-01	0.97192800
74	9 - 1 - 2	0.136421415	0.144389138	0.099262767	0.72761866	2.143947e-02	0.39241248
75	9 - 1 - 3	0.002351138	0.009763324	0.042687741	18.15620395	1.705410e-05	0.04540927
76	9 - 2 - 1	0.094165580	0.131707770	0.085547640	0.90848100	2.736624e-02	0.32648496
77	9 - 2 - 2	0.812675567	0.753285660	0.156690399	0.19280806	3.200541e-01	0.92669720
78	9 - 2 - 3	0.093159383	0.115006558	0.113421567	1.21750019	1.567914e-02	0.44789352
79	9 - 3 - 1	0.001271442	0.005057389	0.007452332	5.86132161	6.462346e-05	0.02082423
80	9 - 3 - 2	0.143526060	0.151403133	0.087495253	0.60961231	2.228528e-02	0.33145368
81	9 - 3 - 3	0.855202467	0.843539474	0.088370637	0.10333300	6.608872e-01	0.97246449

Overall CV on movement
0.03478382

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GROWTH PARAMETER FITS
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	parameter	observed	expected	RMSE	CV	LR2.5	UP97.5
1	mu_Alpha	5.47	5.4148235	0.1020409	0.01865464	5.257590	5.581400
2	mu_Beta	2.89	2.8761663	2.5950962	0.89795717	2.726280	3.049830
3	theta	1.00	0.9818131	4.4882992	4.48829918	0.888644	1.000000

```
4     omega     0.80 0.8011136 4.6688928 5.83611599 0.785695 0.815597
```

d. Design scenario: 30% examination of commercial catch; 30000 tags released

```
Mean number of tags released
  stratum     Tags      Cost
1       1 4913.423  76009.02
2       2 3324.813  51461.94
3       3 2220.863  30071.84
4       4 4263.318  57432.20
5       5 7644.283 103169.85
6       6 4442.460  69206.13
7       7 2731.523  43077.82
8       8 1879.810  29827.68
      tot     Tags     Cost
1 Total   31420.49 460256.5

Mean number of fish examined
  stratum Fishexam     Cost
1       1 246935.2 211296.5
2       2 246810.6 211700.5
3       3 259774.9  94511.5
4       4 259504.0  94415.0
5       5 259620.2  94115.0
6       6 189674.6  92769.0
7       7 189813.1  92799.5
8       8 189168.8  92626.5
       tot    exam     Cost
1 Total    1841301 984233.5

Mean number of tags recovered
  stratum     Tags
1       1 63.54070
2       2 65.56382
3       3 72.19196
4       4 74.03518
5       5 77.25829
6       6 52.10854
7       7 52.57990
8       8 52.82613
       tot     tags
1 Total    510.1045

======================================================================
POPULATION FITS
======================================================================

BY STRATUM & LENGTH

Total fits by length bin

   Numbers
```

	stock	stratum	length_bin	true_pop	exp_pop	RMSE	CV	LR2.5	UP97.5	bias
1	1	1	1	9819394.0	6968074.6	16159731.8	1.6456954	75416.56	29355163	0.7096237
2	1	1	2	1858781.0	1989656.8	1642374.3	0.8835760	68162.67	6502114	1.0704095
3	1	1	3	2720390.0	2589773.5	1678956.9	0.6171751	124113.85	6308954	0.9519861
4	1	1	4	853898.0	1144916.0	1491044.2	1.7461620	38870.32	4071717	1.3408112
5	1	1	5	1432697.0	1631609.8	1447858.5	1.0105825	76035.83	4937344	1.1388380
6	1	1	6	1027808.0	1321419.2	1468592.8	1.4288591	44446.95	4905077	1.2856674
7	1	1	7	1848468.0	1826691.7	1561508.5	0.8447582	77096.71	5062906	0.9882193
8	1	1	8	971744.0	964889.2	1177213.3	1.2114439	38330.82	3201809	0.9929459
9	1	1	9	1038509.6	933919.5	961642.8	0.9259836	45713.73	2909555	0.8992883
10	1	2	1	7148476.0	6795704.3	11312842.0	1.5825530	203452.63	26667084	0.9506508
11	1	2	2	1442488.0	2246599.1	1857197.4	1.2874959	184712.28	6391567	1.5574473
12	1	2	3	1932185.0	3277688.6	2398668.7	1.2414281	473367.18	7656029	1.6963637
13	1	2	4	527582.0	1155137.9	1222190.8	2.3165892	78792.51	3947846	2.1894945
14	1	2	5	848039.0	1822428.2	1786112.4	2.1061678	185480.00	5295721	2.1489910
15	1	2	6	662626.0	1552451.9	1576435.0	2.3790721	134504.66	5123644	2.3428780
16	1	2	7	847296.2	2127821.0	2108733.5	2.4887796	186374.79	6279047	2.5113072
17	1	2	8	322543.0	1012788.2	1131162.1	3.5070118	71424.86	3311958	3.1400100
18	1	2	9	397475.0	868232.3	962738.3	2.4221354	58411.12	2739141	2.1843695
19	2	3	1	4111469.0	4380195.7	9633084.5	2.3429788	133508.66	17961697	1.0653603
20	2	3	2	680678.0	1847097.9	2268834.8	3.3331983	106525.82	6841182	2.7136148
21	2	3	3	1011278.0	2338231.9	2595612.6	2.5666657	161694.69	8421111	2.3121554
22	2	3	4	375713.0	771412.1	989045.2	2.6324487	48108.02	3059418	2.0531952

23	2	3	5	733105.0	1279095.6	1385292.3	1.8896234	98238.36	5090554	1.7447645
24	2	3	6	615578.0	1118636.4	1267884.2	2.0596646	82629.95	4404395	1.8172131
25	2	3	7	928584.0	1587397.8	1586545.8	1.7085646	114951.80	5493878	1.7094822
26	2	3	8	419288.5	821125.5	1017853.5	2.4275731	53637.46	3569542	1.9583782
27	2	3	9	416626.9	723652.9	863444.5	2.0724647	45337.60	2707097	1.7369328
28	2	4	1	8545756.0	4983356.3	7473302.0	0.8745045	94797.32	24293226	0.5831381
29	2	4	2	1626135.0	1703271.4	1722483.4	1.0592500	84362.64	6305709	1.0474354
30	2	4	3	2285581.0	2226689.8	1758097.7	0.7692126	150866.62	6964372	0.9742336
31	2	4	4	686659.0	600354.2	726882.3	1.0585782	36860.50	2527795	0.8743121
32	2	4	5	1183629.0	1059694.1	1077920.2	0.9106909	63138.44	3934414	0.8952925
33	2	4	6	982014.0	849487.5	957911.1	0.9754556	46731.39	3299888	0.8650462
34	2	4	7	1416729.0	1289955.2	1294828.7	0.9139565	69904.70	4699622	0.9105166
35	2	4	8	837158.0	669138.9	728036.6	0.8696525	32663.69	2460236	0.7992982
36	2	4	9	882732.6	719622.5	912087.6	1.0332547	29411.43	2731242	0.8152214
37	2	5	1	17152130.0	7797640.3	13504253.8	0.7873223	155257.82	31076431	0.4546164
38	2	5	2	3592000.0	3249515.8	2399898.3	0.6681231	190437.15	8663925	0.9046536
39	2	5	3	4465180.0	3829107.6	2347910.3	0.5258266	375860.89	8365857	0.8575483
40	2	5	4	1188960.0	1250259.3	1057011.4	0.8890219	75294.22	3938804	1.0515571
41	2	5	5	1920851.0	1987698.3	1378387.0	0.7175919	161408.63	4885964	1.0348009
42	2	5	6	1454071.0	1514751.8	1156538.8	0.7953799	100692.79	4260971	1.0417316
43	2	5	7	1856569.0	1892586.9	1341912.8	0.7227918	123349.13	5135490	1.0194003
44	2	5	8	792360.0	943478.9	930648.9	1.1745279	55157.88	3080346	1.1907200
45	2	5	9	930555.8	873643.1	712335.8	0.7654950	51815.85	2594506	0.9388401
46	3	6	1	9399611.0	9838232.2	45602456.3	4.8515259	74708.40	46356255	1.0466638
47	3	6	2	2008033.0	2350961.8	2205396.5	1.0982870	94424.48	7925627	1.1707785
48	3	6	3	2755678.0	3177572.9	2409644.6	0.8744289	209283.67	9287027	1.1531002
49	3	6	4	726580.0	930219.1	1229277.7	1.6918684	38470.43	3673496	1.2802707
50	3	6	5	1159637.0	1434201.5	1519169.4	1.3100387	51921.56	5119073	1.2367676
51	3	6	6	816555.0	1076037.7	1193220.5	1.4612861	44332.69	4342130	1.3177774
52	3	6	7	1229585.0	1425016.7	1390314.6	1.1307186	64761.45	4607935	1.1589412
53	3	6	8	560148.0	677985.2	1104379.1	1.9715845	26816.53	2980522	1.2103680
54	3	6	9	576602.8	528492.5	614064.1	1.0649689	27583.94	2127648	0.9165624
55	3	7	1	5882663.0	9351735.0	40703870.2	6.9192932	89684.71	58409192	1.5897112
56	3	7	2	1126338.0	937426.8	942488.0	0.8367719	43789.63	3330297	0.8322785
57	3	7	3	1453034.0	1176655.3	1043917.9	0.7184401	57621.76	3782729	0.8097920
58	3	7	4	419144.0	519761.2	851480.2	2.0314742	19485.17	2363790	1.2400541
59	3	7	5	709752.0	686538.7	803136.5	1.1315734	30168.85	2542568	0.9672938
60	3	7	6	458265.0	551660.0	966325.7	2.1086613	21573.30	2603837	1.2038014
61	3	7	7	547681.4	652671.0	912379.8	1.6658952	32985.33	2717216	1.1916983
62	3	7	8	334529.7	587169.6	1231325.3	3.6807652	19733.30	3275092	1.7552091
63	3	7	9	501208.9	707191.9	1473123.4	2.9391406	28647.66	3389822	1.4109724
64	3	8	1	3466915.0	34042434.9	127714042.7	36.8379504	94640.47	321405868	9.8192297
65	3	8	2	631414.0	781626.6	775594.8	1.2283459	65730.65	2418503	1.2378987
66	3	8	3	835650.0	906552.9	507655.5	0.6074978	176825.24	2270866	1.0848476
67	3	8	4	250608.0	514764.2	1300644.7	5.1899567	18828.93	2651503	2.0540614
68	3	8	5	399780.0	591853.7	716327.2	1.7918035	33402.60	2045341	1.4804485
69	3	8	6	341815.0	602003.2	1301610.6	3.8079389	28111.45	2142734	1.7611958
70	3	8	7	597344.9	876685.2	1224143.7	2.0493081	63212.85	3210681	1.4676365
71	3	8	8	396272.7	1098265.4	3511956.2	8.8624731	25465.64	5736380	2.7714889
72	3	8	9	865307.8	2760200.2	6863223.5	7.9315405	76378.12	22209372	3.1898480

biomass

	stock	stratum	length_bin	true_bio	exp_bio	RMSE_bio	CV_bio	LR2.5	UP97.5	bias
2	1	1	2	704.7022	754.9443	623.2035	0.8843503	25.9	2465.5	1.0712956
3	1	1	3	1342.9958	1268.5855	823.2822	0.6130192	60.8	3090.2	0.9445938
4	1	1	4	509.3562	682.9504	889.4182	1.7461614	23.2	2428.8	1.3408109
5	1	1	5	977.2646	1112.4696	987.1867	1.0101529	51.8	3366.1	1.1383505
6	1	1	6	831.0901	1070.2784	1189.8153	1.4316320	36.0	3973.6	1.2878006
7	1	1	7	1961.7952	1926.5188	1647.2161	0.8396473	81.6	5320.2	0.9820183
8	1	1	8	1473.8963	1456.8142	1776.0497	1.2050032	57.9	4839.4	0.9884102
9	1	1	9	3090.5890	2461.9105	2589.3489	0.8378173	120.9	7706.5	0.7965829
11	1	2	2	546.1504	852.4414	705.2083	1.2912346	70.1	2424.1	1.5608180
12	1	2	3	949.1864	1605.5870	1173.4084	1.2362254	231.8	3753.9	1.6915403
13	1	2	4	314.7064	689.0494	729.0458	2.3165903	47.0	2354.9	2.1894993
14	1	2	5	578.4150	1242.5995	1217.7493	2.1053211	126.5	3609.3	2.1482836
15	1	2	6	536.2641	1257.3799	1277.0010	2.3812912	109.0	4150.5	2.3447026
16	1	2	7	877.9498	2243.9878	2233.5767	2.5440826	196.4	6629.2	2.5559410
17	1	2	8	490.2926	1529.1357	1705.8618	3.4792728	108.0	5004.8	3.1188225
18	1	2	9	1223.0119	2289.9673	2458.6139	2.0102944	155.4	7259.8	1.8723999
20	2	3	2	257.9074	701.4274	861.9149	3.3419555	40.5	2599.5	2.7196875
21	2	3	3	500.8869	1146.5530	1270.3852	2.5362714	79.3	4130.8	2.2890455
22	2	3	4	224.1155	460.1540	589.9728	2.6324503	28.7	1825.0	2.0532004
23	2	3	5	500.9594	872.0814	943.9808	1.8843459	67.0	3471.2	1.7408225
24	2	3	6	498.4988	905.6862	1026.4796	2.0591414	66.9	3566.5	1.8168272
25	2	3	7	973.0501	1664.0790	1663.3702	1.7094395	120.6	5760.5	1.7101678
26	2	3	8	628.6183	1242.0343	1541.4422	2.4521113	81.2	5408.8	1.9758162
27	2	3	9	1330.7216	1929.1562	2231.2018	1.6766857	121.1	7230.5	1.4497069
29	2	4	2	617.2185	646.7460	654.0145	1.0596159	32.0	2391.2	1.0478397
30	2	4	3	1123.7044	1091.9130	862.1526	0.7672414	74.1	3410.7	0.9717083
31	2	4	4	409.5970	358.1150	433.5903	1.0585780	22.0	1507.8	0.8743106
32	2	4	5	807.8594	722.5204	735.0479	0.9098711	43.1	2681.2	0.8943641
33	2	4	6	795.8706	687.7750	775.6430	0.9745844	37.8	2673.0	0.8641794

34	2	4	7	1485.0560	1352.1077	1356.9493	0.9137361	73.3	4927.1	0.9104760
35	2	4	8	1270.8213	1012.1057	1102.3975	0.8674686	49.5	3727.7	0.7964186
36	2	4	9	2520.8990	1917.6010	2453.8237	0.9733923	77.5	7260.1	0.7606814
38	2	5	2	1361.1085	1233.9625	911.0099	0.6693147	72.3	3294.2	0.9065865
39	2	5	3	2188.2372	1877.6485	1151.0019	0.5259951	184.0	4102.8	0.8580645
40	2	5	4	709.2231	745.7892	630.5154	0.8890227	44.9	2349.5	1.0515581
41	2	5	5	1311.2956	1355.2967	939.7362	0.7166471	110.1	3331.8	1.0335554
42	2	5	6	1176.7196	1226.4119	936.4030	0.7957741	81.5	3448.0	1.0422294
43	2	5	7	1937.3720	1984.0413	1406.7840	0.7261300	129.4	5382.0	1.0240890
44	2	5	8	1187.4878	1426.9452	1408.6022	1.1862035	83.8	4657.2	1.2016504
45	2	5	9	3263.9906	2330.8697	2113.7105	0.6475847	136.7	6939.8	0.7141166
47	3	6	2	761.2854	891.6738	836.4208	1.0986953	35.8	3006.9	1.1712739
48	3	6	3	1352.8026	1556.0216	1179.5278	0.8719142	102.5	4550.4	1.1502207
49	3	6	4	433.4101	554.8823	733.2730	1.6918686	22.9	2191.3	1.2802708
50	3	6	5	790.4542	977.5169	1035.4145	1.3098982	35.4	3488.5	1.2366521
51	3	6	6	660.4672	871.1908	966.2016	1.4629064	35.9	3518.4	1.3190523
52	3	6	7	1291.9545	1495.2205	1458.5292	1.1289323	68.0	4845.1	1.1573321
53	3	6	8	838.3143	1021.6905	1661.8231	1.9823389	40.5	4476.5	1.2187439
54	3	6	9	2050.4870	1427.4107	1761.6351	0.8591301	75.6	5793.1	0.6961325
56	3	7	2	426.2993	355.5978	357.3408	0.8382393	16.6	1263.2	0.8341505
57	3	7	3	713.8823	576.1445	511.9357	0.7171149	28.3	1852.3	0.8070581
58	3	7	4	250.0224	310.0406	507.9161	2.0314827	11.6	1410.0	1.2400514
59	3	7	5	483.7935	467.9062	547.3782	1.1314294	20.5	1733.1	0.9671611
60	3	7	6	369.9720	446.6628	782.6223	2.1153558	17.5	2106.8	1.2072883
61	3	7	7	575.7413	684.6912	956.8118	1.6618781	34.5	2847.1	1.1892341
62	3	7	8	512.7729	884.8413	1853.1584	3.6139947	29.8	4945.2	1.7256009
63	3	7	9	1661.4012	1913.3216	3963.6645	2.3857360	76.6	9156.7	1.1516313
65	3	8	2	239.2613	296.4830	294.1692	1.2294894	25.0	917.2	1.2391602
66	3	8	3	411.2117	443.9403	248.3665	0.6039870	86.6	1111.4	1.0795906
67	3	8	4	149.4895	307.0582	775.8428	5.1899502	11.2	1581.6	2.0540459
68	3	8	5	273.0141	403.3831	488.0472	1.7876262	22.8	1394.3	1.4775174
69	3	8	6	277.1222	487.4231	1053.8884	3.8029733	22.8	1733.8	1.7588742
70	3	8	7	628.7998	919.8253	1282.9062	2.0402458	66.3	3367.9	1.4628270
71	3	8	8	606.2867	1655.0844	5289.2465	8.7240027	38.2	8638.8	2.7298711
72	3	8	9	2830.4974	7481.8408	18535.2153	6.5483951	204.4	59515.2	2.6432954

BY STOCK & LENGTH

Total fits by length bin

numbers

	stock	length_bin	true_pop	exp_pop	RMSE	CV	bias
1	1	1	16967870	13763779	19726057	1.1625535	0.8111672
4	1	2	3301269	4236256	2479229	0.7509927	1.2832204
7	1	3	4652575	5867462	2927884	0.6293041	1.2611214
10	1	4	1381480	2300054	1927943	1.3955633	1.6649202
13	1	5	2280736	3454038	2299237	1.0081120	1.5144401
16	1	6	1690434	2873871	2154510	1.2745305	1.7000789
19	1	7	2695764	3954513	2623941	0.9733570	1.4669357
22	1	8	1294287	1977677	1632593	1.2613838	1.5280053
25	1	9	1435985	1802152	1360743	0.9476029	1.2549938
2	2	1	29809355	17161192	18193720	0.6103359	0.5756982
5	2	2	5898813	6799885	3724792	0.6314476	1.1527548
8	2	3	7762039	8394029	3916733	0.5046010	1.0814207
11	2	4	2251332	2622026	1619828	0.7194974	1.1646553
14	2	5	3837585	4326488	2231792	0.5815617	1.1273986
17	2	6	3051663	3482876	1965377	0.6440347	1.1413041
20	2	7	4201882	4769940	2448354	0.5826804	1.1351913
23	2	8	2048807	2433743	1559542	0.7611952	1.1878834
26	2	9	2229915	2316918	1443905	0.6475158	1.0390164
3	3	1	18749189	53232402	141588367	7.5517062	2.8391842
6	3	2	3765785	4070015	2520636	0.6693520	1.0807880
9	3	3	5044362	5260781	2674671	0.5302298	1.0429032
12	3	4	1396332	1964745	1981873	1.4193419	1.4070755
15	3	5	2269169	2712594	1861727	0.8204445	1.1954129
18	3	6	1616635	2229701	2012896	1.2451148	1.3792235
21	3	7	2374611	2954373	2064931	0.8695869	1.2441501
24	3	8	1290950	2363420	3881965	3.0070597	1.8307599
27	3	9	1943119	3995885	7046347	3.6263065	2.0564276

biomass

	stock	length_bin	true_bio	exp_bio	RMSE	CV	bias
1	1	2	1250.8526	1607.386	941.1171	0.7523805	1.2850321
4	1	3	2292.1822	2874.173	1433.4158	0.6253498	1.2539023
7	1	4	824.0626	1372.000	1150.0315	1.3955633	1.6649218

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10     1          5 1555.6796  2355.069  1567.6259 1.0076792 1.5138523
13     1          6 1367.3543  2327.658  1745.3917 1.2764736 1.7023081
16     1          7 2839.7450  4170.507  2775.2812 0.9772995 1.4686201
19     1          8 1964.1889  2985.950  2462.5834 1.2537406 1.5201948
22     1          9 4313.6008  4751.878  3570.6456 0.8277645 1.1016035
2      2          2 2236.2343  2582.136  1414.4156 0.6324988 1.1546804
5      2          3 3812.8285  4116.114  1918.8515 0.5032619 1.0795436
8      2          4 1342.9355  1564.058   966.2392 0.7194978 1.1646562
11     2          5 2620.1145  2949.898  1521.3478 0.5806417 1.1258663
14     2          6 2471.0890  2819.873  1591.2677 0.6439540 1.1411459
17     2          7 4395.4781  5000.228  2566.5450 0.5839058 1.1375846
20     2          8 3086.9274  3681.085  2361.2463 0.7649180 1.1924755
23     2          9 7115.6112  6177.627  3932.8468 0.5527068 0.8681794
3      3          2 1426.8460  1543.755   955.9433 0.6699695 1.0819350
6      3          3 2477.8967  2576.106  1309.5991 0.5285124 1.0396343
9      3          4  832.9220  1171.981  1182.2014 1.4193423 1.4070719
12     3          5 1547.2618  1848.806  1268.8169 0.8200402 1.1948891
15     3          6 1307.5613  1805.277  1629.9460 1.2465541 1.3806440
18     3          7 2496.4956  3099.737  2165.3279 0.8673469 1.2416353
21     3          8 1957.3738  3561.616  5845.6805 2.9864916 1.8195891
24     3          9 6542.3856 10822.573 19035.9712 2.9096376 1.6542243
```

```
STRATUM FITS +25cm
   numbers
  stratum true_pop  exp_pop    RMSE        CV      bias
1       1 11752296 12402876 4091633 0.3481560 1.0553577
2       2  6980234 14063147 4798441 0.6874327 2.0147099
3       3  5180851 10486650 4548437 0.8779324 2.0241171
4       4  9900638  9118214 3421146 0.3455481 0.9209724
5       5 16200547 15541042 4336042 0.2676479 0.9592912
6       6  9832819 11600487 4409381 0.4484351 1.1797723
7       7  5549953  5819075 2966576 0.5345227 1.0484908
8       8  4318192  8131951 8105211 1.8769918 1.8831841

   biomass
  stratum  true_bio   exp_bio      RMSE        CV      bias
1       1 10891.689 10734.472  4101.200 0.3765440 0.9855653
2       2  5515.977 11710.148  4411.686 0.7998014 2.1229510
3       3  4914.758  8921.171  3843.268 0.7819852 1.8151802
4       4  9031.026  7788.884  3402.764 0.3767860 0.8624583
5       5 13135.434 12180.965  3569.765 0.2717660 0.9273363
6       6  8179.175  8795.607  3553.382 0.4344426 1.0753660
7       7  4993.885  5639.206  4649.752 0.9310891 1.1292223
8       8  5415.683 11995.038 19372.021 3.5770230 2.2148710
```

```
STOCK FITS +25cm
   numbers
  stock true_pop  exp_pop    RMSE        CV     bias
1     1 18732530 26466023 6306068 0.3366373 1.412838
2     2 31282036 35145905 7154983 0.2287250 1.123517
3     3 19700964 25551513 9692144 0.4919629 1.296968

   biomass
  stock true_bio  exp_bio      RMSE        CV     bias
1     1 16407.67 22444.62  6023.521 0.3671163 1.367935
2     2 27081.22 28891.02  6252.418 0.2308766 1.066829
3     3 18588.74 26429.85 20236.648 1.0886507 1.421820
```

```
SNA 1 FITS (25 cm +)
   numbers
  true_pop  exp_pop     RMSE        CV     bias
1 69715530 87163442 13597718 0.1950458 1.250273

   biomass
  true_bio  exp_bio     RMSE        CV     bias
```

1 62077.63 77765.49 22020.39 0.3547234 1.252714

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==========
TAG RECOVERY FITS
==========

	release	recovery	TagObs	TagExp	RMSE	CV
1	1	1	43.447236181	44.62163670	2.61220899	0.06012371
2	1	2	23.581909548	20.76796288	4.45758091	0.18902544
3	1	3	8.260301508	8.37540539	1.95191009	0.23630010
4	1	4	0.879396985	1.16962477	0.84758160	0.96382136
5	1	5	0.113567839	0.21954266	0.35545885	3.12992525
6	1	6	0.031155779	0.13065913	0.24882985	7.98663537
7	1	7	0.012060302	0.04397799	0.13585470	11.26461851
8	1	8	0.000000000	0.03846881	0.14275051	Inf
9	2	1	15.586934673	16.34695124	3.37849671	0.21675184
10	2	2	26.684422111	26.44236566	2.99259535	0.11214765
11	2	3	16.379899497	14.02930317	3.94227325	0.24067750
12	2	4	2.687437186	3.07996246	1.45134361	0.54004746
13	2	5	0.512562814	0.76759601	0.70042635	1.36651807
14	2	6	0.117587940	0.27535555	0.36515192	3.10535183
15	2	7	0.021105528	0.30116144	0.37099670	17.57817701
16	2	8	0.006030151	0.08957857	0.15407200	25.55027355
17	3	1	3.542713568	4.77837319	2.11555443	0.59715650
18	3	2	10.555778894	10.07132011	2.81006084	0.26621066
19	3	3	19.023115578	21.06700000	3.18996318	0.16768879
20	3	4	8.860301508	10.56344354	3.05722112	0.34504707
21	3	5	2.614070352	3.68299620	1.87971189	0.71907471
22	3	6	0.625125628	0.99372338	0.84048984	1.34451350
23	3	7	0.186934673	0.33396385	0.41338118	2.21136708
24	3	8	0.035175879	0.21945634	0.28167206	8.00753419
25	4	1	0.745728643	0.85440168	0.73418942	0.98452624
26	4	2	3.242211055	2.76085619	1.50840079	0.46523831
27	4	3	17.336683417	13.45188537	4.86529891	0.28063608
28	4	4	31.421105528	31.99093128	2.58795725	0.08236366
29	4	5	13.226130653	12.74865411	3.05694699	0.23112935
30	4	6	3.639195980	3.82927555	1.63883762	0.45032959
31	4	7	0.981909548	1.21148159	0.88058789	0.89681162
32	4	8	0.212060302	0.80633966	0.79098392	3.72999524
33	5	1	0.174874372	0.29477040	0.39662208	2.26804008
34	5	2	1.244221106	1.23955925	0.82158813	0.66032325
35	5	3	8.949748744	8.39994597	2.07753586	0.23213343
36	5	4	23.826130653	22.85213600	3.47541853	0.14586584
37	5	5	45.414070352	46.12961893	2.97033052	0.06540551
38	5	6	15.457286432	15.17614529	3.04743284	0.19715186
39	5	7	4.738693467	5.02893191	1.60593355	0.33889796
40	5	8	1.062311558	1.45925807	0.91578147	0.86206487
41	6	1	0.032160804	0.12824787	0.25109353	7.80743951
42	6	2	0.205025126	0.34583263	0.43407441	2.11717665
43	6	3	1.864321608	1.77368236	1.00471260	0.53891592
44	6	4	5.254271357	5.39562503	1.81556400	0.34554058
45	6	5	12.742713568	12.10574824	2.94940494	0.23145815
46	6	6	24.358793970	24.27491965	2.24600346	0.09220504
47	6	7	10.868341709	10.45000988	2.47605315	0.22782253
48	6	8	2.727638191	2.83379406	1.22795540	0.45018998
49	7	1	0.009045226	0.02501090	0.09554825	10.56339008
50	7	2	0.045226131	0.23061024	0.29737040	6.57518989
51	7	3	0.325628141	0.35915447	0.44130453	1.35524075
52	7	4	0.941708543	1.03192981	0.78285165	0.83130992
53	7	5	2.291457286	2.44567345	1.35399232	0.59088700
54	7	6	6.703517588	6.39053825	2.23304235	0.33311501
55	7	7	27.749748744	28.18122093	1.79709347	0.06476071
56	7	8	11.669346734	11.45031280	2.44379082	0.20941968
57	8	1	0.002010050	0.01487236	0.06940467	34.52882220
58	8	2	0.005025126	0.04593861	0.09387691	18.68150471
59	8	3	0.052261307	0.16081689	0.24276263	4.64516955
60	8	4	0.164824121	0.47051232	0.51218922	3.10748950
61	8	5	0.343718593	0.47567749	0.57748263	1.68010297
62	8	6	1.175879397	1.18475519	1.00104358	0.85131484
63	8	7	8.021105528	7.85851465	2.29143966	0.28567629
64	8	8	37.113567839	35.32185568	2.39046504	0.06440946

	rec_stra	Length_bin	TagObs	TagExp	RMSE	CV

1	1	1	3.024121	3.272595	0.9914695	0.3278538
2	1	2	10.082412	10.669074	1.8250357	0.1810118
3	1	3	16.702513	17.728836	2.4626279	0.1474406
4	1	4	4.026131	4.320765	1.1562126	0.2871771
5	1	5	7.010050	7.252016	1.5069398	0.2149685
6	1	6	4.656281	4.861068	1.1456169	0.2460369
7	1	7	7.036181	7.437990	1.5373175	0.2184875
8	1	8	4.447236	4.666097	1.2285360	0.2762471
9	1	9	6.555779	6.855824	1.4588048	0.2225220
10	2	1	3.382915	3.220418	1.2264014	0.3625280
11	2	2	10.159799	9.716735	2.1007170	0.2067676
12	2	3	17.135678	16.301932	2.8045538	0.1636675
13	2	4	4.166834	3.992786	1.4499437	0.3479725
14	2	5	7.136683	6.763525	1.9263691	0.2699250
15	2	6	4.781910	4.410997	1.5340137	0.3207952
16	2	7	7.632161	7.038199	1.9125690	0.2505934
17	2	8	4.563819	4.254267	1.5396436	0.3373586
18	2	9	6.604020	6.205586	1.7696912	0.2679718
19	3	1	4.092462	3.820549	1.4696540	0.3591124
20	3	2	10.109548	9.291749	2.4462053	0.2419698
21	3	3	18.972864	17.499392	3.4283718	0.1806987
22	3	4	5.519598	5.050269	1.6461066	0.2982294
23	3	5	8.893467	8.325594	2.0106132	0.2260775
24	3	6	5.876382	5.625956	1.7208989	0.2928501
25	3	7	8.494472	8.167404	2.0445929	0.2406969
26	3	8	4.726633	4.497156	1.5140357	0.3203201
27	3	9	5.506533	5.339125	1.6696000	0.3032035
28	4	1	4.440201	4.470193	1.3508639	0.3042349
29	4	2	9.557789	9.777940	2.1159405	0.2213839
30	4	3	18.626131	19.115154	2.7578425	0.1480631
31	4	4	5.792965	5.945547	1.5460916	0.2668913
32	4	5	9.427136	9.762866	1.9459769	0.2064229
33	4	6	6.545729	6.838657	1.6687708	0.2549404
34	4	7	9.623116	10.023176	2.1690049	0.2253953
35	4	8	4.865327	5.141326	1.4946144	0.3071971
36	4	9	5.156784	5.479306	1.5747131	0.3053673
37	5	1	3.916583	4.043141	1.2788946	0.3265333
38	5	2	9.147739	9.348927	1.9585539	0.2141025
39	5	3	18.202010	18.885371	2.8923054	0.1589003
40	5	4	5.720603	5.769260	1.5637607	0.2733559
41	5	5	9.621106	9.784666	1.9816995	0.2059742
42	5	6	7.128643	7.169718	1.6613933	0.2330588
43	5	7	10.908543	11.020271	2.0747361	0.1901937
44	5	8	6.070352	6.038558	1.5045681	0.2478552
45	5	9	6.542714	6.515595	1.4864005	0.2271841
46	6	1	2.464322	2.572325	1.0843768	0.4400305
47	6	2	7.037186	7.120390	1.8854201	0.2679225
48	6	3	13.345729	13.266707	2.5240425	0.1891274
49	6	4	3.554774	3.601472	1.3245264	0.3726050
50	6	5	5.998995	6.107241	1.6943323	0.2824360
51	6	6	4.259296	4.335393	1.4269322	0.3350159
52	6	7	6.882412	6.891074	1.7844703	0.2592798
53	6	8	3.848241	3.792191	1.2919834	0.3357335
54	6	9	4.717588	4.568579	1.3896991	0.2945783
55	7	1	1.923618	1.913469	0.8906803	0.4630235
56	7	2	7.979899	8.254606	1.7336742	0.2172551
57	7	3	14.996985	15.444199	2.4106778	0.1607442
58	7	4	3.434171	3.546013	1.1455377	0.3335704
59	7	5	6.169849	6.305221	1.5479071	0.2508825
60	7	6	4.478392	4.457967	1.2322678	0.2751585
61	7	7	7.148744	7.129053	1.5925853	0.2227783
62	7	8	3.314573	3.284401	1.0958979	0.3306302
63	7	9	3.133668	3.074332	1.0098803	0.3222678
64	8	1	1.828141	1.694462	0.7392418	0.4043681
65	8	2	8.905528	8.766227	1.3347115	0.1498745
66	8	3	17.022111	16.737664	1.8028866	0.1059144
67	8	4	3.833166	3.742768	0.9005063	0.2349250
68	8	5	6.615075	6.522963	1.1987943	0.1812216
69	8	6	4.215075	4.179164	0.9318078	0.2210655
70	8	7	6.063317	6.039161	1.1527149	0.1901129
71	8	8	2.583920	2.664883	0.7958122	0.3079864
72	8	9	1.759799	1.871772	0.7446048	0.4231192

	TagObs	TagExp	RMSE	CV
1	510.1045	509.5993	14.51441	0.02845379

PROPORTIONAL MOVEMENT FITS

	Lb__Fr__To	true_mm	geo_obs	RMSE	CV	LR2.5	UP97.5
1	1 - 1 - 1	0.858749000	0.767373504	0.262758511	0.30597824	3.432233e-02	0.98143700
2	1 - 1 - 2	0.139050975	0.166012532	0.171356895	1.23233149	1.119691e-02	0.67449446
3	1 - 1 - 3	0.002199921	0.066613958	0.203748002	92.61604122	1.781027e-06	0.86755846
4	1 - 2 - 1	0.150323860	0.160092831	0.120831749	0.80380951	8.667543e-03	0.44928622
5	1 - 2 - 2	0.738555933	0.638016243	0.272554662	0.36903727	5.135135e-02	0.95107357
6	1 - 2 - 3	0.111120437	0.201890925	0.229836540	2.06835525	7.765645e-03	0.76511130
7	1 - 3 - 1	0.001321854	0.012755174	0.054891685	41.52628098	4.493574e-06	0.08391074
8	1 - 3 - 2	0.177218823	0.156765698	0.137883395	0.77804035	6.457392e-03	0.50224930
9	1 - 3 - 3	0.821458933	0.830479127	0.147467640	0.17951919	4.417851e-01	0.98994240
10	2 - 1 - 1	0.863663500	0.814098654	0.158700287	0.18375245	3.781120e-01	0.97128450
11	2 - 1 - 2	0.134116670	0.180159396	0.157041586	1.17093264	2.106063e-02	0.61057831
12	2 - 1 - 3	0.002220054	0.005741961	0.008359405	3.76540558	1.604961e-05	0.02533769
13	2 - 2 - 1	0.171122367	0.153253125	0.080021831	0.46762929	3.195709e-02	0.32043254
14	2 - 2 - 2	0.711572533	0.714990244	0.151918771	0.21349724	2.662282e-01	0.90818187
15	2 - 2 - 3	0.117304604	0.131756637	0.116435657	0.99259239	1.654661e-02	0.49661424
16	2 - 3 - 1	0.001286535	0.005744136	0.012890667	10.01967966	6.195185e-05	0.02071946
17	2 - 3 - 2	0.180456522	0.185935503	0.107116585	0.59358666	4.583234e-02	0.43889027
18	2 - 3 - 3	0.818257233	0.808320369	0.109123050	0.13336032	5.550221e-01	0.94981784
19	3 - 1 - 1	0.864165500	0.824137427	0.140877322	0.16302123	4.538464e-01	0.97193850
20	3 - 1 - 2	0.133691885	0.171036951	0.139204796	1.04123595	2.439574e-02	0.53864993
21	3 - 1 - 3	0.002142748	0.004825613	0.006175318	2.88196178	1.426285e-05	0.01828644
22	3 - 2 - 1	0.158601927	0.157206499	0.068134442	0.42959404	4.580604e-02	0.29552685
23	3 - 2 - 2	0.727094067	0.714983647	0.122682905	0.16873044	3.683546e-01	0.88710757
24	3 - 2 - 3	0.114303678	0.127809869	0.093058775	0.81413632	2.757415e-02	0.38588998
25	3 - 3 - 1	0.001250112	0.004959209	0.005905292	4.72381082	9.460994e-05	0.01623380
26	3 - 3 - 2	0.170413280	0.167666819	0.081972180	0.48101991	5.288189e-02	0.36626078
27	3 - 3 - 3	0.828336333	0.827373983	0.082478218	0.09957093	6.231889e-01	0.94501147
28	4 - 1 - 1	0.856559500	0.835623277	0.149430601	0.17445443	3.628486e-01	0.97687300
29	4 - 1 - 2	0.141295110	0.154867745	0.140681657	0.99565835	1.844661e-02	0.51769565
30	4 - 1 - 3	0.002145239	0.009508984	0.046859568	21.84352321	6.507673e-06	0.03975106
31	4 - 2 - 1	0.131129173	0.164725838	0.111197853	0.84800240	2.492803e-02	0.41467273
32	4 - 2 - 2	0.761521600	0.704209883	0.176287380	0.23149360	2.334042e-01	0.92126523
33	4 - 2 - 3	0.107349127	0.131064264	0.119700967	1.11506233	1.454618e-02	0.44301410
34	4 - 3 - 1	0.001289106	0.007283983	0.017524469	13.59427876	3.274381e-05	0.03835230
35	4 - 3 - 2	0.166752871	0.171135392	0.109494660	0.65662834	2.538998e-02	0.42380075
36	4 - 3 - 3	0.831958100	0.821580639	0.111787451	0.13436668	5.522270e-01	0.96712040
37	5 - 1 - 1	0.846992500	0.843954239	0.114224373	0.13485878	5.621700e-01	0.97389625
38	5 - 1 - 2	0.150806710	0.150122665	0.111897508	0.74199290	1.918616e-02	0.42691673
39	5 - 1 - 3	0.002200553	0.005923086	0.013480344	6.12589049	1.113739e-05	0.02771088
40	5 - 2 - 1	0.118294067	0.150894008	0.095197090	0.80474949	3.034154e-02	0.35223644
41	5 - 2 - 2	0.777935800	0.731573025	0.145729145	0.18732798	3.681176e-01	0.91715753
42	5 - 2 - 3	0.103770180	0.117532978	0.101948688	0.98244687	1.449934e-02	0.42955119
43	5 - 3 - 1	0.001322451	0.006800762	0.024730072	18.70017857	6.700224e-05	0.02309132
44	5 - 3 - 2	0.165961482	0.175433838	0.105479584	0.63556665	3.421384e-02	0.43407529
45	5 - 3 - 3	0.832716167	0.817765400	0.109223194	0.13116497	5.438137e-01	0.95635143
46	6 - 1 - 1	0.837647500	0.832468767	0.141130327	0.16848415	4.404787e-01	0.97560915
47	6 - 1 - 2	0.160107570	0.160829813	0.136093524	0.85001305	1.910645e-02	0.52655245
48	6 - 1 - 3	0.002245003	0.006701419	0.034165615	15.21851882	6.666555e-06	0.02790768
49	6 - 2 - 1	0.114179020	0.157113436	0.106447012	0.93228171	2.648775e-02	0.39019968
50	6 - 2 - 2	0.786978667	0.717218495	0.180840810	0.22979125	2.485352e-01	0.92551200
51	6 - 2 - 3	0.098842144	0.125668078	0.120119271	1.21526372	1.417529e-02	0.44533579
52	6 - 3 - 1	0.001487237	0.006877248	0.018298635	12.30378193	4.697538e-05	0.02945422
53	6 - 3 - 2	0.175610207	0.179098073	0.108995905	0.62066953	3.537090e-02	0.44825087
54	6 - 3 - 3	0.822902233	0.814024683	0.111996317	0.13609918	5.291950e-01	0.96012289
55	7 - 1 - 1	0.844123500	0.840354565	0.113875265	0.13490356	5.679938e-01	0.97092550
56	7 - 1 - 2	0.153662120	0.154263640	0.112548792	0.73244331	2.387297e-02	0.42603010
57	7 - 1 - 3	0.002214117	0.005381806	0.011073803	5.00145303	4.743007e-06	0.02541314
58	7 - 2 - 1	0.102319653	0.146062050	0.102029712	0.99716632	3.151444e-02	0.38503808
59	7 - 2 - 2	0.798281833	0.736718888	0.160761296	0.20138413	3.459294e-01	0.92166003
60	7 - 2 - 3	0.099398652	0.117219071	0.103846701	1.04474960	1.552831e-02	0.41365172
61	7 - 3 - 1	0.001373821	0.006763208	0.016760525	12.19992941	2.730150e-05	0.02745084
62	7 - 3 - 2	0.163432494	0.168155610	0.099405651	0.60823677	3.237639e-02	0.40997069
63	7 - 3 - 3	0.835193300	0.825081181	0.102277310	0.12245945	5.794924e-01	0.96110378
64	8 - 1 - 1	0.852767500	0.838256042	0.134437508	0.15764849	5.289725e-01	0.97854300
65	8 - 1 - 2	0.144710545	0.148195162	0.121131764	0.83706245	1.715623e-02	0.42242597
66	8 - 1 - 3	0.002522037	0.013548789	0.064581995	25.60707627	1.202582e-05	0.05950863
67	8 - 2 - 1	0.083600687	0.135707518	0.106122401	1.26939628	1.884682e-02	0.36004585
68	8 - 2 - 2	0.822792333	0.743797363	0.179791126	0.21851337	2.891348e-01	0.93442968
69	8 - 2 - 3	0.093606782	0.120495120	0.122731555	1.31113956	1.284474e-02	0.45716739
70	8 - 3 - 1	0.001254936	0.007020251	0.022451995	17.89094588	3.505808e-05	0.02984400

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71  8 - 3 - 2 0.142892487 0.162785115 0.110387690  0.77252270 2.101389e-02 0.41272351
72  8 - 3 - 3 0.855852667 0.830194635 0.115029820  0.13440376 5.738135e-01 0.97328773
73  9 - 1 - 1 0.861227500 0.841629640 0.127996734  0.14862128 5.268295e-01 0.97810700
74  9 - 1 - 2 0.136421415 0.145690757 0.118586496  0.86926599 1.372207e-02 0.42833015
75  9 - 1 - 3 0.002351138 0.012679597 0.047384664 20.15392716 1.017357e-05 0.07703706
76  9 - 2 - 1 0.094165580 0.130518755 0.094902168  1.00782227 1.697716e-02 0.32794749
77  9 - 2 - 2 0.812675567 0.747450406 0.176777797  0.21752567 2.270546e-01 0.93613163
78  9 - 2 - 3 0.093159383 0.122030850 0.132741578  1.42488683 1.524665e-02 0.51796889
79  9 - 3 - 1 0.001271442 0.005523925 0.009463089  7.44279925 2.324159e-05 0.02548402
80  9 - 3 - 2 0.143526060 0.148409079 0.095667013  0.66654803 1.817952e-02 0.34179914
81  9 - 3 - 3 0.855202467 0.846067007 0.096644570  0.11300782 6.537651e-01 0.97656673


Overall CV on movement
0.04035092


================================================================
GROWTH PARAMETER FITS
================================================================
  parameter observed  expected      RMSE         CV    LR2.5   UP97.5
1  mu_Alpha     5.47 5.4148235 0.1020409 0.01865464 5.257590 5.581400
2   mu_Beta     2.89 2.8761663 2.5950962 0.89795717 2.726280 3.049830
3     theta     1.00 0.9818131 4.4882992 4.48829918 0.888644 1.000000
4     omega     0.80 0.8011136 4.6688928 5.83611599 0.785695 0.815597
```

e. Design scenario: 60% examination of commercial catch; 30000 tags released

```
Mean number of tags released
  stratum     Tags      Cost
1       1 4908.425  76158.77
2       2 3327.770  51474.81
3       3 2223.372  30129.12
4       4 4250.671  57304.01
5       5 7647.880 103304.14
6       6 4432.966  69291.65
7       7 2730.484  42421.20
8       8 1884.508  29738.77
      tot     Tags     Cost
1 Total   31406.08 459822.5

Mean number of fish examined
  stratum Fishexam     Cost
1       1 452868.7 408965.5
2       2 452680.1 408889.0
3       3 468054.1 171668.0
4       4 467730.7 171418.5
5       5 467861.7 171525.0
6       6 337617.7 170890.0
7       7 336859.8 170908.0
8       8 337022.7 170367.0
       tot    exam    Cost
1 Total    3320696 1844631

Mean number of tags recovered
  stratum      Tags
1       1 117.77131
2       2 120.69709
3       3 132.24975
4       4 134.83149
5       5 140.03310
6       6  92.49649
7       7  93.08124
8       8  94.56369
       tot     tags
1 Total    925.7242

================================================================
POPULATION FITS
================================================================

BY STRATUM & LENGTH
```

Total fits by length bin

Numbers

	stock	stratum	length_bin	true_pop	exp_pop	RMSE	CV	LR2.5	UP97.5	bias
1	1	1	1	9819394.0	4991310.2	8693138.4	0.8853029	99449.65	15573470	0.5083114
2	1	1	2	1858781.0	1788047.8	1031975.8	0.5551896	72956.30	4106772	0.9619465
3	1	1	3	2720390.0	2601813.2	1254449.4	0.4611285	251695.82	5277876	0.9564118
4	1	1	4	853898.0	900969.1	713303.8	0.8353501	49241.89	2392175	1.0551250
5	1	1	5	1432697.0	1423913.5	965506.0	0.6739080	96936.30	3481709	0.9938693
6	1	1	6	1027808.0	1089632.5	957880.5	0.9319644	59915.24	3187277	1.0601518
7	1	1	7	1848468.0	1634058.5	1089114.9	0.5891987	86716.31	4080747	0.8840069
8	1	1	8	971744.0	805495.5	614440.8	0.6323073	40261.22	2234732	0.8289174
9	1	1	9	1038509.6	813573.4	551475.7	0.5310261	46675.01	1894124	0.7834049
10	1	2	1	7148476.0	6105335.9	5198069.8	0.7271578	426117.58	18210679	0.8540752
11	1	2	2	1442488.0	2375330.8	1650033.1	1.1438800	430817.10	5726248	1.6466902
12	1	2	3	1932185.0	3179324.5	2010567.7	1.0405669	768059.86	6550605	1.6454555
13	1	2	4	527582.0	1085353.9	942487.8	1.7864290	138105.38	2747142	2.0572231
14	1	2	5	848039.0	1755252.9	1429116.7	1.6852016	311839.60	4496899	2.0697785
15	1	2	6	662626.0	1490237.5	1292207.9	1.9501316	252891.85	3752930	2.2489874
16	1	2	7	847296.2	2071566.1	1815871.9	2.1431371	299614.34	5128321	2.4449137
17	1	2	8	322543.0	965111.3	929820.4	2.8827795	128366.66	2605260	2.9921943
18	1	2	9	397475.0	825832.2	722014.5	1.8165029	109352.17	2251817	2.0776960
19	2	3	1	4111469.0	3817098.1	4069199.0	0.9897190	185790.72	14221576	0.9284025
20	2	3	2	680678.0	1499850.1	1590696.8	2.3369299	139731.06	4985492	2.2034650
21	2	3	3	1011278.0	1938566.8	1793395.6	1.7733953	225646.67	5520566	1.9169475
22	2	3	4	375713.0	628222.9	603064.7	1.6051207	56930.44	2082416	1.6720820
23	2	3	5	733105.0	1122546.9	998231.5	1.3616488	149213.91	3316311	1.5312225
24	2	3	6	615578.0	972307.0	887931.8	1.4424360	99061.49	3050655	1.5795025
25	2	3	7	928584.0	1459025.1	1240468.8	1.3358714	185041.22	4083444	1.5712366
26	2	3	8	419288.5	685871.7	651678.6	1.5542486	70223.29	2369092	1.6357991
27	2	3	9	416626.9	633875.8	610963.7	1.4664528	70199.84	2116946	1.5214472
28	2	4	1	8545756.0	4148125.2	6517145.1	0.7626177	157415.43	16784615	0.4854018
29	2	4	2	1626135.0	1445998.6	1236514.1	0.7604006	104574.27	4633088	0.8892242
30	2	4	3	2285581.0	1949932.6	1294061.3	0.5661848	191060.31	4765141	0.8531453
31	2	4	4	686659.0	542614.5	532557.9	0.7755784	37503.57	1789262	0.7902240
32	2	4	5	1183629.0	890276.2	792835.1	0.6698341	75576.29	2732415	0.7521581
33	2	4	6	982014.0	734662.3	694134.2	0.7068476	54773.46	2441165	0.7481179
34	2	4	7	1416729.0	1048818.0	905876.7	0.6394142	86598.52	3173006	0.7403095
35	2	4	8	837158.0	606875.0	574586.3	0.6863535	44700.20	1977440	0.7249228
36	2	4	9	882732.6	646786.7	583595.8	0.6611241	45328.54	1974562	0.7327097
37	2	5	1	17152130.0	8306943.4	11002596.8	0.6414712	454783.43	22817605	0.4843097
38	2	5	2	3592000.0	3457354.4	1721593.3	0.4792854	474834.81	7370300	0.9625152
39	2	5	3	4465180.0	4264139.4	1875597.3	0.4200496	650260.36	8254580	0.9549759
40	2	5	4	1188960.0	1237998.4	721610.4	0.6069257	150840.35	2942293	1.0412448
41	2	5	5	1920851.0	2025608.5	1002620.9	0.5219670	295859.27	4136958	1.0545370
42	2	5	6	1454071.0	1508419.2	862763.6	0.5933435	183578.08	3372723	1.0373766
43	2	5	7	1856569.0	2006531.1	1008968.3	0.5434586	293868.35	4324537	1.0807738
44	2	5	8	792360.0	938042.2	644773.6	0.8137381	99508.02	2414938	1.1838586
45	2	5	9	930555.8	896988.1	582560.9	0.6260354	93485.10	2396581	0.9639272
46	3	6	1	9399611.0	7011752.2	10223725.8	1.0876754	190380.15	29519406	0.7459620
47	3	6	2	2008033.0	2011842.0	1547153.5	0.7704821	155738.73	5521526	1.0018969
48	3	6	3	2755678.0	2816316.1	1621551.9	0.5884403	455971.91	6788304	1.0220048
49	3	6	4	726580.0	821575.1	759832.8	1.0457661	49039.35	2683249	1.1307428
50	3	6	5	1159637.0	1257742.9	1015092.6	0.8753537	93395.38	3757352	1.0846005
51	3	6	6	816555.0	926593.4	846556.2	1.0367412	56407.88	3035981	1.1347593
52	3	6	7	1229585.0	1254294.8	885808.7	0.7204128	94960.22	3457702	1.0200961
53	3	6	8	560148.0	559893.7	502196.8	0.8965430	41940.34	1796167	0.9995460
54	3	6	9	576602.8	479282.1	465535.5	0.8073764	37340.66	1748351	0.8312171
55	3	7	1	5882663.0	6334651.3	27345701.9	4.6485243	111406.43	33486797	1.0768340
56	3	7	2	1126338.0	875062.1	657279.5	0.5835544	55446.38	2267822	0.7769090
57	3	7	3	1453034.0	1099634.5	729839.8	0.5022868	110177.69	2504073	0.7567851
58	3	7	4	419144.0	419659.9	476939.1	1.1378884	24437.90	1571025	1.0012310
59	3	7	5	709752.0	618110.6	550484.6	0.7756014	49221.99	2035517	0.8708825
60	3	7	6	458265.0	454678.9	472498.6	1.0310598	31887.67	1511215	0.9921746
61	3	7	7	547681.4	577605.2	501166.6	0.9150696	44761.96	1912983	1.0546372
62	3	7	8	334529.7	387393.1	758921.1	2.2686210	25472.76	1446924	1.1580231
63	3	7	9	501208.9	510836.1	761691.8	1.5197092	37183.33	1638931	1.0192080
64	3	8	1	3466915.0	7654711.7	45173842.8	13.0299828	106477.16	44418186	2.2079317
65	3	8	2	631414.0	675613.5	421170.3	0.6670271	111734.15	1820172	1.0700008
66	3	8	3	835650.0	852315.9	338957.7	0.4056216	378456.45	1658576	1.0199436
67	3	8	4	250608.0	321881.5	304290.7	1.2142100	36200.83	1015842	1.2844024
68	3	8	5	399780.0	525446.2	587116.8	1.4685998	95477.98	1499904	1.3143383
69	3	8	6	341815.0	432700.8	355883.1	1.0411571	80581.49	1227966	1.2658917
70	3	8	7	597344.9	678153.9	398725.5	0.6674962	116675.36	1581618	1.1352804
71	3	8	8	396272.7	631464.6	1031559.9	2.6031567	69212.53	2358928	1.5935103
72	3	8	9	865307.8	1408144.7	2680178.2	3.0973699	125153.37	5430700	1.6273340

Biomass

stock	stratum	length_bin	true_bio	exp_bio	RMSE_bio	CV_bio	LR2.5	UP97.5	bias

2	1	1	2	704.7022	678.4955	391.5618	0.5556415	27.7	1559.0	0.9628117	
3	1	1	3	1342.9958	1274.5527	615.6296	0.4584002	123.3	2586.2	0.9490369	
4	1	1	4	509.3562	537.4331	425.4912	0.8353510	29.4	1426.9	1.0551223	
5	1	1	5	977.2646	970.9006	658.2857	0.6736003	66.1	2374.6	0.9934879	
6	1	1	6	831.0901	882.5968	776.0661	0.9337929	48.5	2581.7	1.0619748	
7	1	1	7	1961.7952	1724.1058	1151.6084	0.5870176	91.6	4306.0	0.8788409	
8	1	1	8	1473.8963	1216.3465	929.6131	0.6307181	60.9	3380.7	0.8252593	
9	1	1	9	3090.5890	2144.5595	1631.0807	0.5277572	122.7	5014.2	0.6938999	
11	1	2	2	546.1504	901.3682	626.8391	1.1477407	163.6	2173.9	1.6504029	
12	1	2	3	949.1864	1557.3355	983.1766	1.0358098	376.4	3210.2	1.6407057	
13	1	2	4	314.7064	647.4217	562.2001	1.7864273	82.4	1638.7	2.0572243	
14	1	2	5	578.4150	1196.8470	974.3566	1.6845286	212.6	3065.7	2.0691839	
15	1	2	6	536.2641	1207.0885	1046.9793	1.9523575	204.8	3039.7	2.2509215	
16	1	2	7	877.9498	2185.7081	1926.7470	2.1945982	315.9	5414.4	2.4895594	
17	1	2	8	490.2926	1457.4461	1401.9356	2.8593855	193.6	3939.5	2.9726046	
18	1	2	9	1223.0119	2176.0081	1801.7114	1.4731757	291.6	5988.0	1.7792208	
20	2	3	2	257.9074	569.6134	604.4269	2.3435813	53.1	1892.7	2.2085971	
21	2	3	3	500.8869	950.6365	876.8579	1.7506105	110.6	2710.9	1.8979064	
22	2	3	4	224.1155	374.7382	359.7319	1.6051186	34.0	1242.2	1.6720765	
23	2	3	5	500.9594	765.4130	680.2232	1.3578408	101.8	2261.5	1.5278943	
24	2	3	6	498.4988	787.2204	718.8550	1.4420395	80.2	2469.4	1.5791820	
25	2	3	7	973.0501	1529.6106	1300.7095	1.3367343	194.1	4280.6	1.5719752	
26	2	3	8	628.6183	1037.6153	988.1467	1.5719343	106.3	3583.9	1.6506285	
27	2	3	9	1330.7216	1690.3356	1564.0918	1.1753712	185.0	5610.6	1.2702399	
29	2	4	2	617.2185	549.1556	469.5726	0.7607883	39.7	1761.1	0.8897264	
30	2	4	3	1123.7044	956.2069	635.3556	0.5654117	93.7	2335.6	0.8509417	
31	2	4	4	409.5970	323.6730	317.6757	0.7755812	22.4	1067.3	0.7902232	
32	2	4	5	807.8594	607.0225	540.9047	0.6695530	51.5	1863.9	0.7513962	
33	2	4	6	795.8706	594.8133	562.2939	0.7065142	44.4	1976.2	0.7473745	
34	2	4	7	1485.0560	1099.4699	949.5494	0.6394031	90.6	3321.1	0.7403559	
35	2	4	8	1270.8213	918.0110	870.8865	0.6852943	67.7	2991.1	0.7223762	
36	2	4	9	2520.8990	1724.8807	1628.9518	0.6461789	121.4	5242.8	0.6842324	
38	2	5	2	1361.1085	1313.0289	653.6261	0.4802160	180.2	2798.3	0.9646762	
39	2	5	3	2188.2372	2091.0238	919.5947	0.4202445	318.8	4045.6	0.9555746	
40	2	5	4	709.2231	738.4765	430.4455	0.6069254	90.0	1755.1	1.0412472	
41	2	5	5	1311.2956	1381.1632	683.4644	0.5212130	201.7	2820.3	1.0532813	
42	2	5	6	1176.7196	1221.3059	698.6138	0.5936960	148.6	2731.0	1.0378903	
43	2	5	7	1937.3720	2103.4388	1058.9467	0.5465892	309.0	4536.8	1.0857176	
44	2	5	8	1187.4878	1418.9793	977.8614	0.8234707	150.5	3651.1	1.1949423	
45	2	5	9	3263.9906	2392.1381	1779.2175	0.5451050	251.9	6369.7	0.7328876	
47	3	6	2	761.2854	763.1122	586.8453	0.7708610	59.0	2094.3	1.0023996	
48	3	6	3	1352.8026	1379.0391	793.9492	0.5868921	223.0	3318.3	1.0193942	
49	3	6	4	433.4101	490.0759	453.2479	1.0457713	29.3	1600.6	1.1307441	
50	3	6	5	790.4542	857.2584	691.8816	0.8752963	63.6	2561.5	1.0845137	
51	3	6	6	660.4672	750.2396	685.4630	1.0378456	45.7	2457.0	1.1359226	
52	3	6	7	1291.9545	1316.2654	929.3484	0.7193352	99.6	3629.7	1.0188171	
53	3	6	8	838.3143	843.9272	756.8995	0.9028828	63.0	2705.9	1.0066954	
54	3	6	9	2050.4870	1297.4289	1444.1096	0.7042764	100.3	4676.0	0.6327418	
56	3	7	2	426.2993	331.9156	248.9602	0.5840032	21.0	859.9	0.7785977	
57	3	7	3	713.8823	538.4587	358.5279	0.5022227	53.9	1224.7	0.7542681	
58	3	7	4	250.0224	250.3311	284.4967	1.1378849	14.6	937.1	1.0012348	
59	3	7	5	483.7935	421.2907	375.2003	0.7755381	33.5	1387.9	0.8708068	
60	3	7	6	369.9720	368.1305	382.4944	1.0338470	25.8	1223.0	0.9950227	
61	3	7	7	575.7413	606.1258	525.8499	0.9133441	46.9	2008.3	1.0527745	
62	3	7	8	512.7729	583.8868	1142.9953	2.2290480	38.4	2176.7	1.1386850	
63	3	7	9	1661.4012	1385.4102	2107.4337	1.2684677	99.4	4442.0	0.8338806	
65	3	8	2	239.2613	256.2594	159.7714	0.6677698	42.4	690.6	1.0710442	
66	3	8	3	411.2117	417.3479	165.8734	0.4033771	185.5	811.4	1.0149223	
67	3	8	4	149.4895	192.0056	181.5109	1.2142056	21.6	606.0	1.2844091	
68	3	8	5	273.0141	358.1278	399.9344	1.4648855	65.1	1021.5	1.3117555	
69	3	8	6	277.1222	350.3517	288.0444	1.0394129	65.3	994.3	1.2642496	
70	3	8	7	628.7998	711.7258	418.0702	0.6648702	122.4	1657.7	1.1318797	
71	3	8	8	606.2867	951.9421	1553.8911	2.5629643	104.3	3569.7	1.5701189	
72	3	8	9	2830.4974	3822.4953	7251.2641	2.5618339	337.4	14655.6	1.3504677	

BY STOCK & LENGTH

Total fits by length bin

	numbers stock	length_bin	true_pop	exp_pop	RMSE	CV	bias
1	1	1	16967870	11096646	10128701	0.5969341	0.6539799
4	1	2	3301269	4163379	1946171	0.5895222	1.2611449
7	1	3	4652575	5781138	2369816	0.5093557	1.2425673
10	1	4	1381480	1986323	1181984	0.8555923	1.4378225
13	1	5	2280736	3179166	1724696	0.7562015	1.3939213

```
16     1          6  1690434  2579870  1608520 0.9515426 1.5261584
19     1          7  2695764  3705625  2117442 0.7854702 1.3746101
22     1          8  1294287  1770607  1114497 0.8610895 1.3680171
25     1          9  1435985  1639406   908532 0.6326893 1.1416597
2      2          1 29809355 16272167 13419713 0.4501846 0.5458745
5      2          2  5898813  6403203  2650126 0.4492643 1.0855071
8      2          3  7762039  8152639  2899781 0.3735849 1.0503218
11     2          4  2251332  2408836  1080753 0.4800504 1.0699603
14     2          5  3837585  4038432  1621821 0.4226149 1.0523367
17     2          6  3051663  3215388  1419368 0.4651131 1.0536512
20     2          7  4201882  4514374  1837768 0.4373679 1.0743696
23     2          8  2048807  2230789  1081928 0.5280770 1.0888236
26     2          9  2229915  2177651  1026274 0.4602299 0.9765620
3      3          1 18749189 21001115 53786504 2.8687376 1.1201079
6      3          2  3765785  3562518  1732941 0.4601806 0.9460226
9      3          3  5044362  4768267  1810246 0.3588651 0.9452665
12     3          4  1396332  1563117   947317 0.6784325 1.1194448
15     3          5  2269169  2401300  1295435 0.5708853 1.0582286
18     3          6  1616635  1813973  1032746 0.6388247 1.1220672
21     3          7  2374611  2510054  1093072 0.4603163 1.0570378
24     3          8  1290950  1578751  1375601 1.0655725 1.2229373
27     3          9  1943119  2398263  2824934 1.4538139 1.2342334


   biomass
   stock length_bin  true_bio   exp_bio      RMSE        CV      bias
1      1          2 1250.8526 1579.8637  739.0858 0.5908656 1.2630295
4      1          3 2292.1822 2831.8882 1160.0155 0.5060747 1.2354551
7      1          4  824.0626 1184.8548  705.0615 0.8555922 1.4378213
10     1          5 1555.6796 2167.7476 1175.8873 0.7558673 1.3934409
13     1          6 1367.3543 2089.6853 1303.2437 0.9531134 1.5282691
16     1          7 2839.7450 3909.8139 2244.6728 0.7904487 1.3768187
19     1          8 1964.1889 2673.7927 1682.1427 0.8564058 1.3612706
22     1          9 4313.6008 4320.5676 2430.3473 0.5634150 1.0016151
2      2          2 2236.2343 2431.7979 1006.5075 0.4500903 1.0874522
5      2          3 3812.8285 3997.8672 1420.6375 0.3725941 1.0485306
8      2          4 1342.9355 1436.8878  644.6768 0.4800505 1.0699604
11     2          5 2620.1145 2753.5987 1105.6242 0.4219756 1.0509460
14     2          6 2471.0890 2603.3396 1149.3425 0.4651158 1.0535191
17     2          7 4395.4781 4732.5194 1927.3965 0.4384953 1.0766791
20     2          8 3086.9274 3374.6057 1640.4543 0.5314198 1.0931924
23     2          9 7115.6112 5807.3545 2874.9751 0.4040377 0.8161427
3      3          2 1426.8460 1351.2873  657.1875 0.4605876 0.9470449
6      3          3 2477.8967 2334.8457  886.7984 0.3578835 0.9422692
9      3          4  832.9220  932.4126  565.0825 0.6784339 1.1194478
12     3          5 1547.2618 1636.6768  882.8494 0.5705882 1.0577892
15     3          6 1307.5613 1468.7218  836.1406 0.6394657 1.1232527
18     3          7 2496.4956 2634.1170 1146.7298 0.4593358 1.0551258
21     3          8 1957.3738 2379.7561 2072.1759 1.0586510 1.2157903
24     3          9 6542.3856 6505.3344 7688.1442 1.1751286 0.9943367
```

```
STRATUM FITS +25cm
   numbers
  stratum true_pop  exp_pop    RMSE        CV      bias
1       1 11752296 11057504 2620113 0.2229448 0.9408803
2       2  6980234 13748009 4006084 0.5739183 1.9695627
3       3  5180851  8940266 3198732 0.6174143 1.7256365
4       4  9900638  7865964 2467577 0.2492341 0.7944906
5       5 16200547 16335081 3244258 0.2002561 1.0083043
6       6  9832819 10127540 2932765 0.2982629 1.0299732
7       7  5549953  4942980 1767978 0.3185572 0.8906346
8       8  4318192  5525721 3043465 0.7048008 1.2796375

   biomass
  stratum  true_bio   exp_bio     RMSE        CV      bias
1       1 10891.689  9428.990 2569.005 0.2358684 0.8657050
2       2  5515.977 11329.223 3555.996 0.6446721 2.0538925
3       3  4914.758  7705.183 2712.515 0.5519122 1.5677645
4       4  9031.026  6773.233 2376.429 0.2631406 0.7499959
5       5 13135.434 12659.555 2767.046 0.2106551 0.9637713
6       6  8179.175  7697.347 2377.136 0.2906327 0.9410908
```

```
7       7  4993.885  4485.549 2565.691 0.5137666 0.8982084
8       8  5415.683  7060.256 7449.772 1.3755923 1.3036686
```

```
STOCK FITS +25cm
   numbers
  stock true_pop  exp_pop    RMSE        CV     bias
1     1 18732530 24805513 4786826 0.2555355 1.324194
2     2 31282036 33141311 5181315 0.1656323 1.059436
3     3 19700964 20596242 4581434 0.2325487 1.045443

   biomass
  stock true_bio  exp_bio     RMSE        CV     bias
1     1 16407.67 20758.21 4386.901 0.2673690 1.265153
2     2 27081.22 27137.97 4545.514 0.1678475 1.002096
3     3 18588.74 19243.15 8229.984 0.4427402 1.035205
```

```
SNA 1 FITS (25 cm +)
   numbers
  true_pop  exp_pop    RMSE        CV     bias
1 69715530 78543066 8411259 0.1206511 1.126622

   biomass
  true_bio  exp_bio     RMSE        CV     bias
1 62077.63 67139.34 10374.93 0.1671284 1.081538
```

```
================================================================
TAG RECOVERY FITS
================================================================
   release recovery       TagObs      TagExp       RMSE          CV
1        1        1 80.026078235 81.52708531 3.42277603  0.04277076
2        1        2 43.672016048 39.59292461 6.23821666  0.14284242
3        1        3 15.198595787 15.33155397 2.71912979  0.17890665
4        1        4  1.575727182  1.89608176 1.09059984  0.69212479
5        1        5  0.240722166  0.36187347 0.46065079  1.91362016
6        1        6  0.054162487  0.13480098 0.27440196  5.06627318
7        1        7  0.017051153  0.04674338 0.15457007  9.06508025
8        1        8  0.009027081  0.02851309 0.11115113 12.31307522
9        2        1 29.223671013 31.22285029 4.87127955  0.16668952
10       2        2 49.265797392 46.98747835 4.54808198  0.09231723
11       2        3 29.677031093 26.40522800 5.24951925  0.17688829
12       2        4  4.898696088  5.67709399 2.09253081  0.42716077
13       2        5  1.024072217  1.29447185 0.94469887  0.92249243
14       2        6  0.210631896  0.38970318 0.47613872  2.26052524
15       2        7  0.068204614  0.50179733 0.54364317  7.97076827
16       2        8  0.011033099  0.12170792 0.18295890 16.58272967
17       3        1  6.824473420  8.90922384 3.13929698  0.46000575
18       3        2 19.051153460 19.21433583 3.71334077  0.19491422
19       3        3 34.975927783 37.54433356 4.18693276  0.11970898
20       3        4 16.275827482 20.45644733 5.52106515  0.33921871
21       3        5  4.627883651  6.81551570 2.92550990  0.63214854
22       3        6  1.052156469  1.68669059 1.16798015  1.11008218
23       3        7  0.323971916  0.56174611 0.57849562  1.78563508
24       3        8  0.074222668  0.32324102 0.38689259  5.21259341
25       4        1  1.289869609  1.39853003 0.92414678  0.71646527
26       4        2  5.923771314  5.14736006 2.03973537  0.34433054
27       4        3 31.716148445 25.89794336 7.04218590  0.22203787
28       4        4 56.960882648 57.29679501 3.28490625  0.05766951
29       4        5 24.135406219 23.78754991 3.95517505  0.16387439
30       4        6  6.265797392  6.66166111 2.08880701  0.33336651
31       4        7  1.764292879  2.01418232 1.12283151  0.63642013
32       4        8  0.396188566  1.13678360 1.01255292  2.55573484
33       5        1  0.337011033  0.48685206 0.55815936  1.65620501
34       5        2  2.291875627  2.11313137 1.14286088  0.49865746
35       5        3 16.579739218 15.47956146 2.89348582  0.17451938
36       5        4 43.721163490 42.84476979 4.54581217  0.10397281
37       5        5 81.895687061 81.30564816 4.03053744  0.04921550
38       5        6 27.235707121 27.51931314 3.91545126  0.14376169
```

39	5	7	8.269809428	8.96218078	2.16838783	0.26220530
40	5	8	1.911735206	2.26059018	1.09608237	0.57334424
41	6	1	0.056168506	0.13610602	0.28918784	5.14857630
42	6	2	0.411233701	0.50446031	0.52875307	1.28577272
43	6	3	3.349047141	3.04898912	1.25737803	0.37544352
44	6	4	9.473420261	9.56162556	2.39939567	0.25327660
45	6	5	23.007021063	22.22717529	3.91675608	0.17024177
46	6	6	43.778335005	42.98376944	3.06904332	0.07010416
47	6	7	19.370110331	19.34673239	3.15588697	0.16292561
48	6	8	4.872617854	4.98372214	1.50781996	0.30944761
49	7	1	0.013039117	0.02762954	0.11206826	8.59477386
50	7	2	0.076228686	0.40058821	0.44702063	5.86420481
51	7	3	0.650952859	0.60762647	0.59709182	0.91725816
52	7	4	1.684052156	1.76011911	1.05040727	0.62373797
53	7	5	4.446339017	4.42154161	1.78505909	0.40146716
54	7	6	11.870611836	11.87268859	2.76889326	0.23325615
55	7	7	49.214643932	49.75092566	2.14514800	0.04358760
56	7	8	20.764292879	20.61046812	3.22078133	0.15511153
57	8	1	0.001003009	0.01142821	0.05166665	51.51164977
58	8	2	0.005015045	0.06588614	0.10888236	21.71114314
59	8	3	0.102306921	0.23729990	0.31463188	3.07537237
60	8	4	0.241725176	0.67422920	0.64806597	2.68100321
61	8	5	0.655967904	0.74794798	0.73101269	1.11440314
62	8	6	2.029087262	2.10014157	1.24153490	0.61186866
63	8	7	14.053159478	14.21092365	3.11220124	0.22145918
64	8	8	66.524573721	63.84242765	3.34378366	0.05026389

	rec_stra	Length_bin	TagObs	TagExp	RMSE	CV
1	1	1	5.667001	6.159137	1.561279	0.27550355
2	1	2	18.615848	19.447961	2.464948	0.13241127
3	1	3	30.813440	32.420065	3.545121	0.11505112
4	1	4	7.568706	7.943641	1.571119	0.20758087
5	1	5	13.062187	13.535041	1.958250	0.14991748
6	1	6	8.348044	8.929678	1.791704	0.21462555
7	1	7	13.192578	13.801830	2.207035	0.16729365
8	1	8	8.258776	8.684318	1.686282	0.20418058
9	1	9	12.244734	12.798033	1.979347	0.16164879
10	2	1	6.234704	5.898882	1.756389	0.28171170
11	2	2	18.305918	17.458311	2.992613	0.16347793
12	2	3	31.538616	29.943310	4.071529	0.12909662
13	2	4	7.763290	7.378339	2.054228	0.26460787
14	2	5	13.246740	12.592449	2.663230	0.20104792
15	2	6	8.920762	8.167545	2.310120	0.25895993
16	2	7	13.984955	13.057218	2.803752	0.20048348
17	2	8	8.487462	8.016118	2.073981	0.24435822
18	2	9	12.214644	11.513992	2.463052	0.20164745
19	3	1	7.195587	6.696432	2.015929	0.28016191
20	3	2	18.200602	17.032540	3.416322	0.18770378
21	3	3	34.464393	32.346361	4.853615	0.14082984
22	3	4	9.855567	9.280626	2.276350	0.23097095
23	3	5	16.479438	15.496764	2.875703	0.17450249
24	3	6	11.001003	10.355380	2.451328	0.22282772
25	3	7	15.724173	15.035783	2.787964	0.17730432
26	3	8	8.971916	8.407624	2.120546	0.23635380
27	3	9	10.357071	9.901025	2.302222	0.22228504
28	4	1	7.869609	7.960957	1.895761	0.24089644
29	4	2	17.217653	17.820977	2.977364	0.17292511
30	4	3	34.117352	35.150197	4.097981	0.12011428
31	4	4	10.391174	10.745052	2.179525	0.20974774
32	4	5	17.291876	18.083676	2.897502	0.16756436
33	4	6	11.966901	12.598677	2.361076	0.19730056
34	4	7	17.759278	18.512001	2.805375	0.15796672
35	4	8	9.015045	9.409807	2.056277	0.22809394
36	4	9	9.202608	9.885817	2.306763	0.25066403
37	5	1	7.237713	7.168427	1.759181	0.24305763
38	5	2	16.578736	16.757705	2.862294	0.17264850
39	5	3	33.097292	33.621475	3.995343	0.12071511
40	5	4	10.357071	10.367922	2.096178	0.20239101
41	5	5	17.704112	17.815104	2.715062	0.15335773
42	5	6	13.011033	13.023505	2.369860	0.18214235
43	5	7	19.888666	19.957039	2.747545	0.13814624
44	5	8	10.616851	10.707524	2.027296	0.19095079
45	5	9	11.541625	11.543023	2.115735	0.18331341
46	6	1	4.324975	4.513892	1.439720	0.33288514
47	6	2	12.983952	12.994161	2.562891	0.19738913
48	6	3	23.495486	23.620844	3.441732	0.14648481

49	6	4	6.192578	6.322999	1.686605	0.27235904
50	6	5	10.813440	10.984095	2.316551	0.21422890
51	6	6	7.592778	7.747010	1.973345	0.25989760
52	6	7	12.176530	12.378732	2.402016	0.19726607
53	6	8	6.612839	6.689756	1.682854	0.25448289
54	6	9	8.303912	8.097281	1.850790	0.22288175
55	7	1	3.359077	3.472316	1.219993	0.36319279
56	7	2	13.743230	14.490473	2.408503	0.17525012
57	7	3	26.445336	27.525284	3.355672	0.12689090
58	7	4	6.101304	6.356564	1.600995	0.26240211
59	7	5	11.007021	11.205038	2.013367	0.18291662
60	7	6	7.801404	7.871465	1.768899	0.22674112
61	7	7	12.801404	12.822643	2.226701	0.17394193
62	7	8	6.123370	6.060758	1.482473	0.24210076
63	7	9	5.699097	5.590691	1.493508	0.26206037
64	8	1	3.339017	3.321591	0.968487	0.29005152
65	8	2	16.302909	15.930910	1.829577	0.11222396
66	8	3	30.422267	29.769482	2.437061	0.08010779
67	8	4	6.927783	6.722534	1.176746	0.16985902
68	8	5	11.418255	11.287754	1.534528	0.13439251
69	8	6	7.561685	7.481938	1.299033	0.17179142
70	8	7	10.721163	10.667337	1.528545	0.14257270
71	8	8	4.610832	4.679884	1.018878	0.22097485
72	8	9	3.259779	3.446025	1.071765	0.32878441

	TagObs	TagExp	RMSE	CV
1	925.7242	925.4787	20.26528	0.02189128

PROPORTIONAL MOVEMENT FITS

	Lb__Fr__To	true_mm	geo_obs	RMSE	CV	LR2.5	UP97.5
1	1 - 1 - 1	0.858749000	0.793123368	0.221988512	0.25850221	6.111684e-02	0.97269450
2	1 - 1 - 2	0.139050975	0.174548547	0.175282193	1.26056069	1.814877e-02	0.81002589
3	1 - 1 - 3	0.002199921	0.032328103	0.140004580	63.64072184	3.792435e-06	0.48794527
4	1 - 2 - 1	0.150323860	0.158696781	0.095898131	0.63794351	1.630547e-02	0.35480677
5	1 - 2 - 2	0.738555933	0.683846930	0.194453501	0.26328879	1.517198e-01	0.92095177
6	1 - 2 - 3	0.111120437	0.157456276	0.158883844	1.42983458	1.300986e-02	0.57993128
7	1 - 3 - 1	0.001321854	0.010857795	0.056430117	42.69012555	9.253107e-06	0.03029467
8	1 - 3 - 2	0.177218823	0.173835870	0.123921412	0.69925649	2.163481e-02	0.41989557
9	1 - 3 - 3	0.821458933	0.815306348	0.134426808	0.16364398	4.754549e-01	0.97353563
10	2 - 1 - 1	0.863663500	0.833688709	0.117228463	0.13573395	5.559995e-01	0.96601200
11	2 - 1 - 2	0.134116670	0.161918715	0.115934279	0.86442855	2.976966e-02	0.43747759
12	2 - 1 - 3	0.002220054	0.004392573	0.005071350	2.28433603	3.879256e-05	0.01772046
13	2 - 2 - 1	0.171122367	0.162882141	0.064112922	0.37466126	5.464342e-02	0.29392045
14	2 - 2 - 2	0.711572533	0.719820158	0.110987715	0.15597527	4.275925e-01	0.88414783
15	2 - 2 - 3	0.117304604	0.117297709	0.083436266	0.71127870	2.245874e-02	0.33910011
16	2 - 3 - 1	0.001286535	0.004552706	0.004661916	3.62362184	1.582481e-04	0.01277766
17	2 - 3 - 2	0.180456522	0.193631108	0.083524954	0.46285362	6.355428e-02	0.39337274
18	2 - 3 - 3	0.818257233	0.801816184	0.084416835	0.10316662	6.017509e-01	0.93204470
19	3 - 1 - 1	0.864165500	0.843973766	0.094767479	0.10966358	6.372875e-01	0.95982450
20	3 - 1 - 2	0.133691885	0.152190646	0.094042567	0.70342764	3.795703e-02	0.35838812
21	3 - 1 - 3	0.002142748	0.003835594	0.003603778	1.68184875	1.057391e-04	0.01243802
22	3 - 2 - 1	0.158601927	0.161394139	0.054127412	0.34127840	6.989528e-02	0.26805547
23	3 - 2 - 2	0.727094067	0.723490876	0.081853675	0.11257646	5.296046e-01	0.85271293
24	3 - 2 - 3	0.114303678	0.115114982	0.059736023	0.52260806	3.613041e-02	0.28554928
25	3 - 3 - 1	0.001250112	0.004368445	0.004313203	3.45025392	2.522369e-04	0.01101147
26	3 - 3 - 2	0.170413280	0.175492081	0.061442770	0.36055154	7.160113e-02	0.30769813
27	3 - 3 - 3	0.828336333	0.820139483	0.062106174	0.07497700	6.873121e-01	0.92235317
28	4 - 1 - 1	0.856559500	0.850151589	0.098887957	0.11544786	6.065472e-01	0.97029525
29	4 - 1 - 2	0.141295110	0.144989804	0.097985755	0.69348299	2.459778e-02	0.37769753
30	4 - 1 - 3	0.002145239	0.004858608	0.006869303	3.20211625	3.714844e-05	0.02170569
31	4 - 2 - 1	0.131129173	0.164854262	0.086404844	0.65892922	4.628954e-02	0.35746703
32	4 - 2 - 2	0.761521600	0.712560756	0.141490788	0.18580010	3.587924e-01	0.88894690
33	4 - 2 - 3	0.107349127	0.122584993	0.097172522	0.90520086	1.937454e-02	0.40005444
34	4 - 3 - 1	0.001289106	0.005176867	0.006315062	4.89879074	1.261691e-04	0.01680687
35	4 - 3 - 2	0.166752871	0.179975458	0.088523871	0.53086865	5.092952e-02	0.40030718
36	4 - 3 - 3	0.831958100	0.814847680	0.089637386	0.10774267	5.905013e-01	0.94469253
37	5 - 1 - 1	0.846992500	0.848099952	0.088918136	0.10498102	6.430150e-01	0.95983100
38	5 - 1 - 2	0.150806710	0.147695195	0.088307839	0.58556969	3.505992e-02	0.34794051
39	5 - 1 - 3	0.002200553	0.004204868	0.004860932	2.20895969	7.066263e-05	0.01536498

```
40  5 - 2 - 1 0.118294067 0.155932706 0.085084339  0.71926125 4.802473e-02 0.31378178
41  5 - 2 - 2 0.777935800 0.733423504 0.121754698  0.15650996 4.719942e-01 0.88789420
42  5 - 2 - 3 0.103770180 0.110643785 0.077358720  0.74548122 2.333965e-02 0.33745625
43  5 - 3 - 1 0.001322451 0.005309778 0.009542974  7.21612571 1.197788e-04 0.01579291
44  5 - 3 - 2 0.165961482 0.175951782 0.074338911  0.44792870 4.980891e-02 0.33573761
45  5 - 3 - 3 0.832716167 0.818738446 0.075256842  0.09037514 6.548258e-01 0.94303107
46  6 - 1 - 1 0.837647500 0.840490402 0.097393900  0.11627075 6.103711e-01 0.96394135
47  6 - 1 - 2 0.160107570 0.155398301 0.096411165  0.60216494 3.119989e-02 0.38613213
48  6 - 1 - 3 0.002245003 0.004111315 0.005239642  2.33391347 5.551106e-05 0.01675695
49  6 - 2 - 1 0.114179020 0.159674925 0.093587424  0.81965517 4.493186e-02 0.34393969
50  6 - 2 - 2 0.786978667 0.729318643 0.139571497  0.17735106 3.960795e-01 0.89111320
51  6 - 2 - 3 0.098842144 0.111006448 0.088778765  0.89818737 1.563529e-02 0.35015368
52  6 - 3 - 1 0.001487237 0.005994700 0.021520597 14.47019008 1.472883e-04 0.01701377
53  6 - 3 - 2 0.175610207 0.179782313 0.086478942  0.49244827 4.264916e-02 0.38628430
54  6 - 3 - 3 0.822902233 0.814222996 0.088773598  0.10787867 6.019100e-01 0.94985353
55  7 - 1 - 1 0.844123500 0.845329371 0.084170395  0.09971337 6.466040e-01 0.95560550
56  7 - 1 - 2 0.153662120 0.150906615 0.083784575  0.54525198 4.236150e-02 0.33969496
57  7 - 1 - 3 0.002214117 0.003763992 0.004235296  1.91286002 5.993351e-05 0.01316930
58  7 - 2 - 1 0.102319653 0.146547995 0.082326697  0.80460297 4.344424e-02 0.30341915
59  7 - 2 - 2 0.798281833 0.749491745 0.106592637  0.13352757 5.187500e-01 0.88394973
60  7 - 2 - 3 0.099398652 0.103960273 0.064051743  0.64439248 2.197091e-02 0.28920216
61  7 - 3 - 1 0.001373821 0.004927263 0.005372093  3.91032868 2.887420e-04 0.01558895
62  7 - 3 - 2 0.163432494 0.172998945 0.071978760  0.44041890 6.091122e-02 0.34527651
63  7 - 3 - 3 0.835193300 0.822073796 0.073070068  0.08748881 6.461120e-01 0.93617220
64  8 - 1 - 1 0.852767500 0.850128730 0.089876180  0.10539353 6.352070e-01 0.96758300
65  8 - 1 - 2 0.144710545 0.144790231 0.088493514  0.61152084 2.681239e-02 0.35701413
66  8 - 1 - 3 0.002522037 0.005081056 0.008525666  3.38046819 5.975445e-05 0.02129349
67  8 - 2 - 1 0.083600687 0.138649421 0.089440601  1.06985486 3.819394e-02 0.30938988
68  8 - 2 - 2 0.822792333 0.760581907 0.124676768  0.15152884 4.921732e-01 0.91130803
69  8 - 2 - 3 0.093606782 0.100768671 0.075728982  0.80901170 1.871083e-02 0.28205068
70  8 - 3 - 1 0.001254936 0.005358699 0.008076249  6.43558572 1.409213e-04 0.01906767
71  8 - 3 - 2 0.142892487 0.160907756 0.082928301  0.58035453 3.722463e-02 0.33556602
72  8 - 3 - 3 0.855852667 0.833733537 0.084591537  0.09883890 6.563744e-01 0.95709882
73  9 - 1 - 1 0.861227500 0.850278318 0.100925662  0.11718816 6.268356e-01 0.96864385
74  9 - 1 - 2 0.136421415 0.143184905 0.096810334  0.70964177 2.713450e-02 0.35920008
75  9 - 1 - 3 0.002351138 0.006536772 0.030011762 12.76478116 3.022271e-05 0.02394249
76  9 - 2 - 1 0.094165580 0.129265899 0.077202810  0.81986231 3.392910e-02 0.28760950
77  9 - 2 - 2 0.812675567 0.769644872 0.123254537  0.15166512 5.019834e-01 0.91566873
78  9 - 2 - 3 0.093159383 0.101089216 0.088421367  0.94914075 1.654967e-02 0.31515152
79  9 - 3 - 1 0.001271442 0.004670769 0.005665391  4.45587733 6.498806e-05 0.01644130
80  9 - 3 - 2 0.143526060 0.155851019 0.073949739  0.51523563 4.095851e-02 0.31697197
81  9 - 3 - 3 0.855202467 0.839478197 0.074889403  0.08756921 6.741758e-01 0.95739530


Overall CV on movement
0.03046877


================================================================
GROWTH PARAMETER FITS
================================================================
  parameter observed  expected       RMSE         CV    LR2.5   UP97.5
1  mu_Alpha     5.47 5.4095509 0.08839998 0.01616087 5.290580 5.540920
2   mu_Beta     2.89 2.8669008 2.60383996 0.90098268 2.764140 2.996900
3     theta     1.00 0.9878910 4.48216437 4.48216437 0.922789 1.000000
4     omega     0.80 0.8014756 4.66852790 5.83565987 0.789937 0.812365
```

f. Design scenario: 90% examination of commercial catch; 30000 tags released

```
Mean number of tags released
  stratum     Tags      Cost
1       1 4910.094  76002.78
2       2 3327.831  51280.74
3       3 2226.400  29913.95
4       4 4254.578  57419.73
5       5 7647.127 103220.63
6       6 4441.606  69289.32
7       7 2735.442  42932.83
8       8 1883.633  29754.40
      tot     Tags     Cost
1 Total   31426.71 459814.4

Mean number of fish examined
  stratum Fishexam     Cost
1       1 659615.7 605998.5
```

```
2       2 659985.8 606478.5
3       3 677485.2 248802.0
4       4 677359.0 248754.0
5       5 676586.5 248175.5
6       6 484364.0 248623.0
7       7 484434.8 248683.5
8       8 484790.0 248959.0
       tot    exam    Cost
1 Total    4804621 2704474

Mean number of tags recovered
  stratum    Tags
1       1 170.883
2       2 175.406
3       3 192.709
4       4 195.501
5       5 202.098
6       6 133.231
7       7 134.327
8       8 136.790
       tot     tags
1 Total    1340.945

======================================================================
POPULATION FITS
======================================================================

BY STRATUM & LENGTH

Total fits by length bin

   Numbers

   stock stratum length_bin   true_pop   exp_pop       RMSE        CV      LR2.5     UP97.5      bias
1      1       1          1  9819394.0 4697290.5  6126814.3 0.6239503  132183.24 12604224.9 0.4783687
2      1       1          2  1858781.0 1791731.9   944348.1 0.5080470  146923.80  3904767.9 0.9639285
3      1       1          3  2720390.0 2600776.7   981554.2 0.3608138  525068.45  4772089.7 0.9560308
4      1       1          4   853898.0  860626.9   551661.8 0.6460512   56183.85  2136170.9 1.0078802
5      1       1          5  1432697.0 1348422.6   716146.6 0.4998591  118978.28  2906361.3 0.9411778
6      1       1          6  1027808.0 1042924.7   664474.5 0.6464967   62199.85  2748580.0 1.0147078
7      1       1          7  1848468.0 1650178.6   937903.6 0.5073951  109735.02  3611468.9 0.8927277
8      1       1          8   971744.0  818320.9   532394.8 0.5478755   57346.93  1935572.6 0.8421157
9      1       1          9  1038509.6  786648.1   506508.4 0.4877262   50371.51  1755560.6 0.7574780
10     1       2          1  7148476.0 5933330.1  4400533.2 0.6155904  630372.84 14183526.8 0.8300133
11     1       2          2  1442488.0 2441022.3  1570752.7 1.0889191  569951.09  5363323.4 1.6922306
12     1       2          3  1932185.0 3247715.6  1852821.0 0.9589253  948221.36  6157801.5 1.6808512
13     1       2          4   527582.0 1070446.8   845587.5 1.6027603  211728.21  2642791.7 2.0289677
14     1       2          5   848039.0 1754975.5  1309892.2 1.5446131  387729.42  3829046.2 2.0694514
15     1       2          6   662626.0 1458221.1  1142114.8 1.7236190  266612.67  3359872.4 2.2006699
16     1       2          7   847296.2 1983042.7  1604249.8 1.8933754  374439.19  4618458.8 2.3404361
17     1       2          8   322543.0  898632.7   810686.4 2.5134211  167792.50  2238210.0 2.7860866
18     1       2          9   397475.0  806347.9   640977.9 1.6126244  144157.50  1959491.2 2.0286757
19     2       3          1  4111469.0 3190899.3  3507691.9 0.8531481  260756.73 10906462.7 0.7760971
20     2       3          2   680678.0 1298118.2  1300794.8 1.9110281  161732.25  3898521.9 1.9070958
21     2       3          3  1011278.0 1613894.3  1384130.1 1.3686940  259934.10  4464506.1 1.5958958
22     2       3          4   375713.0  589652.5   542890.1 1.4449596   83239.85  1862175.9 1.5694226
23     2       3          5   733105.0 1025898.7   756786.6 1.0323031  149717.32  2608119.5 1.3993885
24     2       3          6   615578.0  873918.5   671443.3 1.0907526  117330.97  2377331.6 1.4196715
25     2       3          7   928584.0 1297407.2   940547.2 1.0128832  202324.82  3269656.1 1.3971889
26     2       3          8   419288.5  683065.1   607181.0 1.4481222   73081.03  2057954.8 1.6291052
27     2       3          9   416626.9  612957.9   544424.9 1.3067446   79316.62  1980039.8 1.4712395
28     2       4          1  8545756.0 3656891.1  5789076.8 0.6774213  211366.13 11993785.0 0.4279190
29     2       4          2  1626135.0 1464422.9  1039637.5 0.6393303  142407.67  4092340.7 0.9005544
30     2       4          3  2285581.0 2145490.3  1171616.1 0.5126119  381184.82  4896733.8 0.9387067
31     2       4          4   686659.0  543457.8   439348.5 0.6398351   58340.78  1538313.1 0.7914522
32     2       4          5  1183629.0  914050.4   684165.5 0.5780236  125849.41  2520477.5 0.7722440
33     2       4          6   982014.0  729507.5   607169.4 0.6182899   78373.17  2183853.4 0.7428687
34     2       4          7  1416729.0 1100586.2   801270.6 0.5655779  143559.96  2856476.3 0.7768502
35     2       4          8   837158.0  598327.0   498468.2 0.5954290   61914.35  1706410.2 0.7147122
36     2       4          9   882732.6  639409.6   523269.9 0.5927842   57295.47  1765108.8 0.7243525
37     2       5          1 17152130.0 7944674.7 10332594.5 0.6024088  463297.47 18370112.5 0.4631888
38     2       5          2  3592000.0 3416001.7  1525929.8 0.4248134  763240.91  6530656.5 0.9510027
39     2       5          3  4465180.0 4236509.0  1623201.4 0.3635243 1211270.67  8015036.7 0.9487880
40     2       5          4  1188960.0 1221132.3   617955.0 0.5197441  212497.40  2599304.3 1.0270592
41     2       5          5  1920851.0 1980311.6   874434.9 0.4552331  520380.71  3965004.5 1.0309553
42     2       5          6  1454071.0 1516156.7   751698.7 0.5169615  289415.68  3290488.1 1.0426979
43     2       5          7  1856569.0 1968908.3   848003.9 0.4567586  419406.61  3653538.9 1.0605091
44     2       5          8   792360.0  874039.7   496685.7 0.6268435  152456.24  2176408.7 1.1030841
45     2       5          9   930555.8  866193.1   459417.6 0.4937024  146196.38  1939885.3 0.9308342
46     3       6          1  9399611.0 6781439.4  8561619.0 0.9108482  193352.04 25498290.5 0.7214596
47     3       6          2  2008033.0 1981088.5  1283391.0 0.6391285  215423.97  5104242.8 0.9865816
48     3       6          3  2755678.0 2583059.4  1288050.5 0.4674169  578614.24  5638022.6 0.9373590
49     3       6          4   726580.0  790691.8   624076.6 0.8589234   65984.43  2359032.3 1.0882377
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50	3	6	5	1159637.0	1208288.2	757060.1	0.6528423	144564.98	3135637.0	1.0419538
51	3	6	6	816555.0	877398.8	594279.0	0.7277881	111008.11	2495976.5	1.0745128
52	3	6	7	1229585.0	1183290.0	714027.7	0.5807062	128360.53	2921906.3	0.9623491
53	3	6	8	560148.0	553077.8	441724.3	0.7885849	58986.26	1650186.2	0.9873781
54	3	6	9	576602.8	449565.5	354297.7	0.6144570	45632.78	1183590.6	0.7796796
55	3	7	1	5882663.0	4024351.5	9420940.8	1.6014755	232249.63	18746208.4	0.6841037
56	3	7	2	1126338.0	877994.0	603721.6	0.5360039	78325.14	1971638.6	0.7795121
57	3	7	3	1453034.0	1172057.0	601387.9	0.4138843	141077.30	2269408.1	0.8066273
58	3	7	4	419144.0	372343.3	307570.0	0.7338052	37144.65	1077839.5	0.8883422
59	3	7	5	709752.0	603149.8	399694.3	0.5631465	55925.16	1519870.3	0.8498037
60	3	7	6	458265.0	424466.5	297430.8	0.6490366	36474.33	1058825.4	0.9262469
61	3	7	7	547681.4	552649.3	385809.4	0.7044413	45298.14	1467508.4	1.0090708
62	3	7	8	334529.7	367743.6	312874.9	0.9352680	31709.85	1144292.4	1.0992853
63	3	7	9	501208.9	439025.5	372931.4	0.7440639	41146.49	1349005.4	0.8759332
64	3	8	1	3466915.0	5994329.8	17408770.0	5.0214009	245549.14	59938587.8	1.7290097
65	3	8	2	631414.0	627725.5	256741.0	0.4066128	259505.49	1259695.4	0.9941584
66	3	8	3	835650.0	812213.2	243550.6	0.2914505	421993.26	1392835.9	0.9719538
67	3	8	4	250608.0	284803.8	202992.5	0.8100000	53037.09	759654.8	1.1364514
68	3	8	5	399780.0	447626.1	222299.7	0.5560552	138459.83	981341.6	1.1196810
69	3	8	6	341815.0	373565.0	221698.4	0.6485917	99547.75	982385.0	1.0928865
70	3	8	7	597344.9	639375.3	297354.3	0.4977934	264307.79	1350799.1	1.0703620
71	3	8	8	396272.7	492243.6	496650.3	1.2533043	104824.51	1473422.1	1.2421840
72	3	8	9	865307.8	1147764.6	1609624.5	1.8601758	229217.64	3412963.0	1.3264236

	biomass									
	stock	stratum	length_bin	true_bio	exp_bio	RMSE_bio	CV_bio	LR2.5	UP97.5	bias
2	1	1	2	704.7022	679.8987	358.30025	0.5084421	55.8	1482.4	0.9648029
3	1	1	3	1342.9958	1274.0302	482.21965	0.3590627	257.4	2337.4	0.9486479
4	1	1	4	509.3562	513.3696	329.07098	0.6460527	33.5	1274.2	1.0078793
5	1	1	5	977.2646	919.4665	488.36863	0.4997302	81.1	1982.4	0.9408573
6	1	1	6	831.0901	844.7934	538.27383	0.6476720	50.4	2225.4	1.0164883
7	1	1	7	1961.7952	1741.3484	992.01633	0.5056676	115.9	3809.4	0.8876301
8	1	1	8	1473.8963	1235.8014	805.83872	0.5467405	86.5	2921.1	0.8384589
9	1	1	9	3090.5890	2071.9735	1541.17831	0.4986682	131.8	4581.0	0.6704138
11	1	2	2	546.1504	926.3051	596.86181	1.0928525	216.3	2034.9	1.6960623
12	1	2	3	949.1864	1590.9341	905.67822	0.9541627	464.4	3016.5	1.6761029
13	1	2	4	314.7064	638.5280	504.39811	1.6027577	126.3	1576.4	2.0289641
14	1	2	5	578.4150	1196.6866	893.09265	1.5440344	264.3	2610.7	2.0689065
15	1	2	6	536.2641	1181.1754	925.46430	1.7257621	215.9	2723.1	2.2026001
16	1	2	7	877.9498	2092.5629	1704.27545	1.9411993	395.4	4873.4	2.3834654
17	1	2	8	490.2926	1357.1060	1222.04292	2.4924766	253.5	3375.4	2.7679510
18	1	2	9	1223.0119	2125.4954	1583.95317	1.2951249	375.0	5179.6	1.7379189
20	2	3	2	257.9074	493.0177	494.31020	1.9166192	61.4	1480.3	1.9116077
21	2	3	3	500.8869	791.4367	676.59939	1.3508026	127.6	2189.6	1.5800706
22	2	3	4	224.1155	351.7321	323.83867	1.4449635	49.7	1110.8	1.5694236
23	2	3	5	500.9594	699.4894	515.56890	1.0291630	102.1	1778.6	1.3962995
24	2	3	6	498.4988	707.5807	543.60961	1.0904933	95.0	1925.9	1.4194230
25	2	3	7	973.0501	1360.0449	986.06184	1.0133721	212.6	3425.7	1.3977131
26	2	3	8	628.6183	1033.3469	921.08742	1.4652570	110.6	3117.3	1.6438383
27	2	3	9	1330.7216	1635.7056	1387.94667	1.0430031	209.3	5280.1	1.2291870
29	2	4	2	617.2185	556.1715	394.77623	0.6396054	54.1	1554.5	0.9010934
30	2	4	3	1123.7044	1052.1167	574.81935	0.5115396	186.9	2400.7	0.9362931
31	2	4	4	409.5970	324.1740	262.07559	0.6398377	34.8	917.6	0.7914463
32	2	4	5	807.8594	623.2344	466.82629	0.5778559	85.8	1718.7	0.7714639
33	2	4	6	795.8706	590.6527	491.93829	0.6181134	63.5	1767.5	0.7421467
34	2	4	7	1485.0560	1153.7320	839.94736	0.5655998	150.5	2995.7	0.7768946
35	2	4	8	1270.8213	905.1272	756.12824	0.5949918	93.6	2578.8	0.7122380
36	2	4	9	2520.8990	1705.4103	1480.75153	0.5873903	151.7	4674.3	0.6765088
38	2	5	2	1361.1085	1297.3481	579.16323	0.4255085	289.8	2479.6	0.9531556
39	2	5	3	2188.2372	2077.4930	795.72940	0.3636395	594.2	3930.4	0.9493912
40	2	5	4	709.2231	728.4142	368.61537	0.5197453	126.8	1550.5	1.0270594
41	2	5	5	1311.2956	1350.2418	596.08224	0.4545750	354.8	2702.9	1.0297005
42	2	5	6	1176.7196	1227.5743	608.68397	0.5172719	234.3	2664.1	1.0432173
43	2	5	7	1937.3720	2064.0936	890.08238	0.4594277	440.3	3834.0	1.0654090
44	2	5	8	1187.4878	1322.3334	753.37401	0.6344267	230.9	3292.7	1.1135554
45	2	5	9	3263.9906	2310.2750	1541.51258	0.4722785	386.8	5168.6	0.7078069
47	3	6	2	761.2854	751.4590	486.78767	0.6394286	81.7	1937.6	0.9870923
48	3	6	3	1352.8026	1264.8445	631.18568	0.4665763	283.6	2758.0	0.9349808
49	3	6	4	433.4101	471.6526	372.26518	0.8589213	39.4	1407.2	1.0882362
50	3	6	5	790.4542	823.5310	515.98533	0.6527707	98.5	2137.1	1.0418453
51	3	6	6	660.4672	710.4239	481.26128	0.7286680	89.9	2021.7	1.0756385
52	3	6	7	1291.9545	1241.9754	749.71279	0.5802935	134.6	3066.0	0.9613151
53	3	6	8	838.3143	833.6410	665.53260	0.7938939	89.0	2489.4	0.9944253
54	3	6	9	2050.4870	1218.4520	1223.81392	0.5968406	123.0	3210.9	0.5942257
56	3	7	2	426.2993	333.0324	228.62308	0.5362971	29.7	747.7	0.7812173
57	3	7	3	713.8823	573.9482	295.61119	0.4140895	69.0	1111.6	0.8039816
58	3	7	4	250.0224	222.1061	183.46731	0.7338036	22.2	642.9	0.8883449
59	3	7	5	483.7935	411.0906	272.42828	0.5631086	38.1	1035.6	0.8497233
60	3	7	6	369.9720	343.6746	240.69905	0.6505873	29.6	857.2	0.9289207

61	3	7	7	575.7413	579.9472	404.87071	0.7032164	47.6	1539.3	1.0073052
62	3	7	8	512.7729	554.3269	470.89736	0.9183352	47.8	1725.3	1.0810379
63	3	7	9	1661.4012	1189.2440	1101.09319	0.6627497	110.0	3641.4	0.7158078
65	3	8	2	239.2613	238.1074	97.38202	0.4070113	98.5	478.2	0.9951774
66	3	8	3	411.2117	397.7167	119.46329	0.2905153	206.7	681.2	0.9671823
67	3	8	4	149.4895	169.8872	121.08681	0.8100024	31.6	453.1	1.1364494
68	3	8	5	273.0141	305.0916	151.40478	0.5545676	94.3	668.8	1.1174938
69	3	8	6	277.1222	302.4715	179.46614	0.6476065	80.6	795.5	1.0914733
70	3	8	7	628.7998	670.9819	311.82862	0.4959108	277.6	1418.3	1.0670835
71	3	8	8	606.2867	741.9123	746.92605	1.2319685	157.6	2223.1	1.2236989
72	3	8	9	2830.4974	3110.1803	4289.26541	1.5153751	624.3	9307.2	1.0988105

BY STOCK & LENGTH

Total fits by length bin

numbers

	stock	length_bin	true_pop	exp_pop	RMSE	CV	bias
1	1	1	16967870	10630621	7543377.6	0.4445683	0.6265147
4	1	2	3301269	4232754	1832773.2	0.5551723	1.2821597
7	1	3	4652575	5848492	2096758.1	0.4506662	1.2570442
10	1	4	1381480	1931074	1009628.1	0.7308308	1.3978297
13	1	5	2280736	3103398	1492877.6	0.6545596	1.3607003
16	1	6	1690434	2501146	1321345.0	0.7816602	1.4795880
19	1	7	2695764	3633221	1858300.4	0.6893409	1.3477519
22	1	8	1294287	1716954	969874.5	0.7493504	1.3265633
25	1	9	1435985	1592996	816947.6	0.5689111	1.1093406
2	2	1	29809355	14792465	12352320.6	0.4143773	0.4962357
5	2	2	5898813	6178543	2258622.4	0.3828944	1.0474214
8	2	3	7762039	7995894	2433779.7	0.3135490	1.0301280
11	2	4	2251332	2354243	932536.9	0.4142156	1.0457110
14	2	5	3837585	3920261	1343668.4	0.3501338	1.0215437
17	2	6	3051663	3119583	1176665.5	0.3855817	1.0222566
20	2	7	4201882	4366902	1498590.8	0.3566475	1.0392728
23	2	8	2048807	2155432	929427.8	0.4536435	1.0520426
26	2	9	2229915	2118561	883897.3	0.3963816	0.9500633
3	3	1	18749189	16800121	21566657.5	1.1502715	0.8960452
6	3	2	3765785	3486808	1441349.5	0.3827487	0.9259180
9	3	3	5044362	4567330	1442240.7	0.2859114	0.9054326
12	3	4	1396332	1447839	724759.8	0.5190455	1.0368873
15	3	5	2269169	2259064	884484.4	0.3897834	0.9955469
18	3	6	1616635	1675430	700558.9	0.4333439	1.0363689
21	3	7	2374611	2375315	864351.8	0.3639972	1.0002961
24	3	8	1290950	1413065	734624.1	0.5690568	1.0945928
27	3	9	1943119	2036356	1689821.2	0.8696435	1.0479827

biomass

	stock	length_bin	true_bio	exp_bio	RMSE	CV	bias
1	1	2	1250.8526	1606.2038	696.1488	0.5565394	1.2840872
4	1	3	2292.1822	2864.9643	1026.0550	0.4476324	1.2498851
7	1	4	824.0626	1151.8976	602.2501	0.7308305	1.3978277
10	1	5	1555.6796	2116.1531	1017.8990	0.6543115	1.3602757
13	1	6	1367.3543	2025.9688	1070.6180	0.7829851	1.4816707
16	1	7	2839.7450	3833.9113	1971.9663	0.6944167	1.3500900
19	1	8	1964.1889	2592.9074	1463.8186	0.7452535	1.3200906
22	1	9	4313.6008	4197.4689	2210.0086	0.5123350	0.9730777
2	2	2	2236.2343	2346.5373	857.6834	0.3835392	1.0493253
5	2	3	3812.8285	3921.0464	1192.2203	0.3126866	1.0283826
8	2	4	1342.9355	1404.3203	556.2665	0.4142168	1.0457094
11	2	5	2620.1145	2672.9656	915.9979	0.3496022	1.0201713
14	2	6	2471.0890	2525.8077	952.8960	0.3856178	1.0221435
17	2	7	4395.4781	4577.8705	1571.6476	0.3575601	1.0414955
20	2	8	3086.9274	3260.8075	1409.8597	0.4567194	1.0563279
23	2	9	7115.6112	5651.3909	2548.5843	0.3581680	0.7942242
3	3	2	1426.8460	1322.5988	546.5474	0.3830458	0.9269387
6	3	3	2477.8967	2236.5094	707.1441	0.2853808	0.9025838
9	3	4	832.9220	863.6459	432.3235	0.5190445	1.0368869
12	3	5	1547.2618	1539.7132	602.8113	0.3895988	0.9951213
15	3	6	1307.5613	1356.5700	567.2359	0.4338121	1.0374810
18	3	7	2496.4956	2492.9045	907.3184	0.3634368	0.9985615
21	3	8	1957.3738	2129.8802	1105.7018	0.5648905	1.0881315
24	3	9	6542.3856	5517.8763	4594.3361	0.7022417	0.8434043

```
STRATUM FITS +25cm
   numbers
  stratum true_pop  exp_pop    RMSE        CV      bias
1       1 11752296 10899630 2129231 0.1811757 0.9274469
2       2  6980234 13660405 3643783 0.5220144 1.9570123
3       3  5180851  7994912 2544773 0.4911883 1.5431658
4       4  9900638  8135252 2155832 0.2177468 0.8216897
5       5 16200547 16079252 2802084 0.1729623 0.9925129
6       6  9832819  9626460 2335044 0.2374745 0.9790133
7       7  5549953  4809429 1206145 0.2173252 0.8665711
8       8  4318192  4825317 1786331 0.4136756 1.1174391

   biomass
  stratum  true_bio   exp_bio     RMSE        CV      bias
1       1 10891.689  9280.682 2237.442 0.2054266 0.8520884
2       2  5515.977 11108.793 3160.991 0.5730610 2.0139305
3       3  4914.758  7072.354 2261.734 0.4601923 1.4390035
4       4  9031.026  6910.619 2117.722 0.2344940 0.7652086
5       5 13135.434 12377.773 2359.318 0.1796148 0.9423193
6       6  8179.175  7315.979 1942.811 0.2375314 0.8944642
7       7  4993.885  4207.370 1379.688 0.2762755 0.8425044
8       8  5415.683  5936.349 4375.669 0.8079626 1.0961405
```

```
STOCK FITS +25cm
   numbers
  stock true_pop  exp_pop    RMSE        CV      bias
1     1 18732530 24560035 4220282 0.2252916 1.3110901
2     2 31282036 32209417 4356048 0.1392508 1.0296458
3     3 19700964 19261206 3177765 0.1613000 0.9776784

   biomass
  stock true_bio  exp_bio     RMSE        CV      bias
1     1 16407.67 20389.48 3872.727 0.2360315 1.2426798
2     2 27081.22 26360.75 3894.428 0.1438055 0.9733959
3     3 18588.74 17459.70 4982.423 0.2680344 0.9392619
```

```
SNA 1 FITS (25 cm +)
   numbers
  true_pop  exp_pop    RMSE         CV     bias
1 69715530 76030658 6847198 0.09821625 1.090584

   biomass
  true_bio  exp_bio     RMSE        CV     bias
1 62077.63 64209.92 7415.465 0.1194547 1.034349
```

```
==================================================================
TAG RECOVERY FITS
==================================================================
   release recovery  TagObs       TagExp       RMSE          CV
1        1        1 116.701 118.36016203 3.94675715  0.03381939
2        1        2  63.041  57.45594715 8.05480387  0.12777088
3        1        3  22.224  22.08373280 3.37826967  0.15200997
4        1        4   2.287   2.67505857 1.24579988  0.54473104
5        1        5   0.322   0.45521494 0.53163867  1.65105179
6        1        6   0.076   0.15541907 0.30716195  4.04160460
7        1        7   0.030   0.05098064 0.15000862  5.00028732
8        1        8   0.006   0.02488263 0.09731215 16.21869099
9        2        1  41.928  45.30558583 6.44745984  0.15377456
10       2        2  71.722  67.85261112 6.14407129  0.08566509
11       2        3  42.997  39.04050360 6.30312864  0.14659461
12       2        4   7.106   8.20480655 2.50624198  0.35269378
13       2        5   1.578   1.89109148 1.15828138  0.73401862
14       2        6   0.303   0.52158586 0.54308879  1.79237226
```

15	2	7	0.078	0.67535591	0.70542951	9.04396812
16	2	8	0.023	0.16712294	0.23862807	10.37513351
17	3	1	9.649	12.91878623	4.33710254	0.44948726
18	3	2	27.833	28.67628447	4.62533911	0.16618184
19	3	3	51.011	53.96754195	4.97343158	0.09749724
20	3	4	23.373	30.20184876	8.02869103	0.34350280
21	3	5	6.808	10.00768784	4.06484400	0.59706874
22	3	6	1.691	2.48628527	1.42630345	0.84346745
23	3	7	0.461	0.74747978	0.68827107	1.49299582
24	3	8	0.121	0.44638326	0.48834604	4.03591770
25	4	1	1.980	1.97662693	1.12695000	0.56916667
26	4	2	8.759	7.48214585	2.63309469	0.30061590
27	4	3	46.305	38.25009018	9.28201569	0.20045385
28	4	4	82.366	82.27336094	3.99801759	0.04853966
29	4	5	34.637	34.67317105	4.92457187	0.14217663
30	4	6	8.935	9.58872291	2.53563045	0.28378628
31	4	7	2.558	2.72733720	1.23679532	0.48350091
32	4	8	0.571	1.55293491	1.24768558	2.18508859
33	5	1	0.527	0.60366428	0.54430128	1.03282975
34	5	2	3.325	3.08937780	1.34796280	0.40540235
35	5	3	24.226	22.69815203	3.54923609	0.14650525
36	5	4	63.689	62.43148381	5.52779510	0.08679356
37	5	5	118.106	117.23389133	4.52891918	0.03834622
38	5	6	39.350	39.90361655	4.68247315	0.11899551
39	5	7	12.019	12.69808778	2.52251961	0.20987766
40	5	8	2.838	3.16196711	1.27835527	0.45044231
41	6	1	0.075	0.16083288	0.30848101	4.11308020
42	6	2	0.606	0.68981284	0.59914818	0.98869336
43	6	3	4.972	4.53867205	1.57208572	0.31618780
44	6	4	13.983	13.84563396	2.76984839	0.19808685
45	6	5	33.544	32.53914175	4.57606883	0.13641989
46	6	6	62.724	61.61105905	3.54599567	0.05653332
47	6	7	27.912	28.07749171	3.72240426	0.13336215
48	6	8	7.035	7.04971197	1.71938009	0.24440371
49	7	1	0.021	0.03161936	0.13030506	6.20500297
50	7	2	0.106	0.55143702	0.58255029	5.49575745
51	7	3	0.854	0.82519495	0.68180607	0.79836776
52	7	4	2.325	2.40407619	1.15013823	0.49468311
53	7	5	6.163	6.31546522	2.15508964	0.34968191
54	7	6	17.188	17.23832646	3.51840492	0.20470124
55	7	7	70.697	71.50767433	2.41756002	0.03419608
56	7	8	30.079	30.02040016	3.79739619	0.12624742
57	8	1	0.002	0.01005042	0.05337579	26.68789731
58	8	2	0.014	0.09226084	0.15208207	10.86300475
59	8	3	0.120	0.33225348	0.38590311	3.21585927
60	8	4	0.372	0.94024745	0.82585111	2.22002988
61	8	5	0.940	1.05952997	0.91382981	0.97215937
62	8	6	2.964	2.97000095	1.45716812	0.49162217
63	8	7	20.572	20.62746592	3.65262376	0.17755317
64	8	8	96.117	92.66091046	4.11623290	0.04282523

	rec_stra	Length_bin	TagObs	TagExp	RMSE	CV
1	1	1	8.197	8.772180	1.787544	0.21807292
2	1	2	26.519	27.886278	3.176901	0.11979718
3	1	3	44.938	47.040503	4.297717	0.09563660
4	1	4	10.832	11.414832	1.909891	0.17631935
5	1	5	18.797	19.619445	2.525267	0.13434414
6	1	6	12.296	12.929343	2.000672	0.16270916
7	1	7	19.341	20.221463	2.738709	0.14160122
8	1	8	11.902	12.586550	2.121205	0.17822260
9	1	9	18.061	18.896735	2.534901	0.14035221
10	2	1	9.066	8.580163	2.083058	0.22976594
11	2	2	26.193	25.015292	3.763251	0.14367391
12	2	3	45.254	43.175537	5.116414	0.11305992
13	2	4	11.246	10.685191	2.305898	0.20504158
14	2	5	19.346	18.349257	3.321000	0.17166337
15	2	6	12.888	11.898987	2.653130	0.20586046
16	2	7	20.630	19.345239	3.585018	0.17377690
17	2	8	12.600	11.798302	2.628971	0.20864847
18	2	9	18.183	17.041910	3.156632	0.17360350
19	3	1	10.470	9.857420	2.445419	0.23356435
20	3	2	26.420	24.686213	4.414180	0.16707720
21	3	3	50.140	47.192986	6.125302	0.12216399
22	3	4	14.601	13.522633	2.797489	0.19159570
23	3	5	24.252	22.687999	3.821663	0.15758136
24	3	6	16.069	15.319260	2.787861	0.17349313

25	3	7	23.214	22.172647	3.493672	0.15049849
26	3	8	12.768	12.020454	2.676597	0.20963322
27	3	9	14.775	14.276529	2.777238	0.18796874
28	4	1	11.407	11.607709	2.323470	0.20368806
29	4	2	25.225	25.851865	3.573078	0.14164830
30	4	3	49.210	50.294062	4.831309	0.09817738
31	4	4	14.985	15.554424	2.600599	0.17354679
32	4	5	25.021	26.243702	3.538202	0.14140931
33	4	6	17.576	18.423923	2.986618	0.16992590
34	4	7	25.617	26.878937	3.760532	0.14679829
35	4	8	12.889	13.695586	2.673377	0.20741539
36	4	9	13.571	14.426308	2.698666	0.19885533
37	5	1	10.232	10.365779	2.108771	0.20609573
38	5	2	23.813	24.064334	3.480591	0.14616347
39	5	3	47.161	48.428512	4.737228	0.10044799
40	5	4	14.764	14.918783	2.445458	0.16563653
41	5	5	25.514	25.832561	3.243788	0.12713758
42	5	6	18.802	18.838410	2.744318	0.14595883
43	5	7	28.907	29.014906	3.536715	0.12234805
44	5	8	15.926	15.793013	2.657356	0.16685649
45	5	9	16.979	16.918894	2.619403	0.15427307
46	6	1	6.334	6.538293	1.809985	0.28575706
47	6	2	18.474	18.553580	3.083478	0.16690904
48	6	3	34.241	34.401061	4.108386	0.11998440
49	6	4	8.770	9.041247	2.133972	0.24332636
50	6	5	15.645	15.729370	2.864684	0.18310542
51	6	6	10.842	11.051824	2.361933	0.21785028
52	6	7	17.684	17.877487	2.923919	0.16534263
53	6	8	9.415	9.576603	2.148599	0.22821025
54	6	9	11.826	11.705551	2.237143	0.18917156
55	7	1	4.871	4.989112	1.467968	0.30136883
56	7	2	19.869	20.932049	3.021432	0.15206766
57	7	3	37.763	39.192759	4.220471	0.11176208
58	7	4	9.082	9.238439	1.977057	0.21768966
59	7	5	15.833	16.229048	2.578675	0.16286713
60	7	6	11.219	11.349194	2.092107	0.18647896
61	7	7	18.731	18.473043	2.657975	0.14190245
62	7	8	8.682	8.584488	1.911201	0.22013374
63	7	9	8.277	8.123742	1.706743	0.20620313
64	8	1	4.787	4.635674	1.130039	0.23606421
65	8	2	23.445	22.960235	2.115569	0.09023540
66	8	3	43.830	42.824943	3.036317	0.06927485
67	8	4	9.927	9.810640	1.466635	0.14774203
68	8	5	17.000	16.708654	1.845256	0.10854449
69	8	6	11.255	11.116465	1.546179	0.13737711
70	8	7	15.420	15.551476	1.850460	0.12000390
71	8	8	6.502	6.598476	1.246154	0.19165696
72	8	9	4.624	4.877751	1.246204	0.26950777

	TagObs	TagExp	RMSE	CV
1	1340.945	1340.816	24.96608	0.01861827

PROPORTIONAL MOVEMENT FITS

	Lb__Fr__To	true_mm	geo_obs	RMSE	CV	LR2.5	UP97.5
1	1 - 1 - 1	0.858749000	0.827794917	0.170710688	0.19878997	1.022274e-01	0.967066500
2	1 - 1 - 2	0.139050975	0.148253240	0.126900980	0.91262201	2.233175e-02	0.472235030
3	1 - 1 - 3	0.002199921	0.023951840	0.120983946	54.99467025	6.844725e-05	0.128666970
4	1 - 2 - 1	0.150323860	0.165716452	0.082086914	0.54606710	2.826147e-02	0.333995921
5	1 - 2 - 2	0.738555933	0.671880418	0.190042006	0.25731566	1.175894e-01	0.890045700
6	1 - 2 - 3	0.111120437	0.162403129	0.160454649	1.44397064	2.079753e-02	0.623064557
7	1 - 3 - 1	0.001321854	0.005693004	0.019763175	14.95110174	1.154033e-04	0.016175841
8	1 - 3 - 2	0.177218823	0.166313992	0.092054693	0.51944083	2.136555e-02	0.361077311
9	1 - 3 - 3	0.821458933	0.827993011	0.095280519	0.11598939	6.286915e-01	0.975151033
10	2 - 1 - 1	0.863663500	0.846102457	0.103822968	0.12021229	6.140769e-01	0.961468000
11	2 - 1 - 2	0.134116670	0.150069005	0.103067960	0.76849478	3.657466e-02	0.381205300
12	2 - 1 - 3	0.002220054	0.003828536	0.003569503	1.60784503	1.019986e-04	0.012136914
13	2 - 2 - 1	0.171122367	0.173289306	0.056109143	0.32788901	6.834956e-02	0.284185035
14	2 - 2 - 2	0.711572533	0.710328015	0.095445797	0.13413362	4.929549e-01	0.850556333
15	2 - 2 - 3	0.117304604	0.116382676	0.069561141	0.59299583	3.051354e-02	0.289287099

16	2 - 3 - 1	0.001286535	0.004435324	0.004234110	3.29109671	2.406317e-04	0.011179452
17	2 - 3 - 2	0.180456522	0.187827007	0.067234906	0.37258230	8.194962e-02	0.348991170
18	2 - 3 - 3	0.818257233	0.807737657	0.067873862	0.08294930	6.432173e-01	0.911366300
19	3 - 1 - 1	0.864165500	0.857733616	0.075200197	0.08702060	6.853190e-01	0.955357500
20	3 - 1 - 2	0.133691885	0.138489344	0.074577395	0.55783038	4.190356e-02	0.302132380
21	3 - 1 - 3	0.002142748	0.003777032	0.003110751	1.45175785	3.364784e-04	0.009846224
22	3 - 2 - 1	0.158601927	0.171231389	0.049540560	0.31235787	8.284577e-02	0.256368741
23	3 - 2 - 2	0.727094067	0.718017083	0.068510352	0.09422488	5.652528e-01	0.834029400
24	3 - 2 - 3	0.114303678	0.110751530	0.044739867	0.39141232	4.237633e-02	0.232143605
25	3 - 3 - 1	0.001250112	0.004592627	0.004105843	3.28438073	6.689236e-04	0.009971764
26	3 - 3 - 2	0.170413280	0.180233613	0.052164338	0.30610489	9.603379e-02	0.297257418
27	3 - 3 - 3	0.828336333	0.815173771	0.053217036	0.06424569	6.963396e-01	0.899994467
28	4 - 1 - 1	0.856559500	0.858946935	0.085474092	0.09978769	6.555780e-01	0.956784500
29	4 - 1 - 2	0.141295110	0.136773215	0.084857390	0.60056848	3.882278e-02	0.332823585
30	4 - 1 - 3	0.002145239	0.004279840	0.005465670	2.54781450	8.872897e-05	0.015847721
31	4 - 2 - 1	0.131129173	0.163873300	0.078058057	0.59527605	5.088321e-02	0.326596367
32	4 - 2 - 2	0.761521600	0.720213607	0.122207021	0.16047742	4.425306e-01	0.878762000
33	4 - 2 - 3	0.107349127	0.115913097	0.077411492	0.72111897	2.727229e-02	0.338088981
34	4 - 3 - 1	0.001289106	0.004811498	0.005094027	3.95159559	2.050580e-04	0.012709633
35	4 - 3 - 2	0.166752871	0.178153135	0.072348153	0.43386452	6.298204e-02	0.329095080
36	4 - 3 - 3	0.831958100	0.817035373	0.073344876	0.08815934	6.659898e-01	0.931307967
37	5 - 1 - 1	0.846992500	0.853734878	0.071676352	0.08462454	6.876445e-01	0.954470000
38	5 - 1 - 2	0.150806710	0.142272821	0.071062270	0.47121425	4.296440e-02	0.310477685
39	5 - 1 - 3	0.002200553	0.003992303	0.003583258	1.62834467	2.056932e-04	0.012028092
40	5 - 2 - 1	0.118294067	0.155105753	0.070979940	0.60002959	5.847496e-02	0.286213327
41	5 - 2 - 2	0.777935800	0.735954373	0.097704324	0.12559433	5.318175e-01	0.875373967
42	5 - 2 - 3	0.103770180	0.108939883	0.059894116	0.57718042	3.037774e-02	0.268366007
43	5 - 3 - 1	0.001322451	0.004862332	0.004578966	3.46248405	3.805253e-04	0.012269734
44	5 - 3 - 2	0.165961482	0.174316126	0.063300765	0.38141841	7.984865e-02	0.314707848
45	5 - 3 - 3	0.832716167	0.820821550	0.064188961	0.07708384	6.780180e-01	0.914428533
46	6 - 1 - 1	0.837647500	0.849510382	0.078623558	0.09386234	6.676637e-01	0.957371350
47	6 - 1 - 2	0.160107570	0.146908203	0.078391499	0.48961769	3.925087e-02	0.321242636
48	6 - 1 - 3	0.002245003	0.003581407	0.003882629	1.72945388	1.400812e-04	0.012065023
49	6 - 2 - 1	0.114179020	0.158754909	0.082762622	0.72484965	5.344481e-02	0.308332617
50	6 - 2 - 2	0.786978667	0.735381013	0.110666529	0.14062202	5.136441e-01	0.882448000
51	6 - 2 - 3	0.098842144	0.105864080	0.063303381	0.64044929	2.478984e-02	0.265774987
52	6 - 3 - 1	0.001487237	0.004863399	0.004776351	3.21156099	3.191088e-04	0.012965363
53	6 - 3 - 2	0.175610207	0.181678903	0.071120077	0.40498829	6.439183e-02	0.352661164
54	6 - 3 - 3	0.822902233	0.813457699	0.071891655	0.08736354	6.362730e-01	0.930792620
55	7 - 1 - 1	0.844123500	0.853868106	0.067217046	0.07962940	6.974180e-01	0.946070500
56	7 - 1 - 2	0.153662120	0.142638304	0.066789470	0.43465149	4.880409e-02	0.299087825
57	7 - 1 - 3	0.002214117	0.003493591	0.003441448	1.55432061	1.110684e-04	0.011298487
58	7 - 2 - 1	0.102319653	0.145119800	0.074896790	0.73198830	5.296518e-02	0.286707372
59	7 - 2 - 2	0.798281833	0.754288008	0.093569865	0.11721407	5.683010e-01	0.887300833
60	7 - 2 - 3	0.099398652	0.100592194	0.051955376	0.52269699	2.688846e-02	0.225531883
61	7 - 3 - 1	0.001373821	0.004719470	0.004892340	3.56111803	3.087388e-04	0.012921233
62	7 - 3 - 2	0.163432494	0.175460824	0.067171366	0.41100374	7.099349e-02	0.318400560
63	7 - 3 - 3	0.835193300	0.819819705	0.068439513	0.08194452	6.747710e-01	0.924543700
64	8 - 1 - 1	0.852767500	0.851573967	0.080808873	0.09476073	6.669245e-01	0.960360000
65	8 - 1 - 2	0.144710545	0.143728129	0.080127614	0.55370957	3.660883e-02	0.327357200
66	8 - 1 - 3	0.002522037	0.004697907	0.005343446	2.11870261	1.225623e-04	0.018725302
67	8 - 2 - 1	0.083600687	0.131626452	0.080501634	0.96293029	4.057677e-02	0.294953764
68	8 - 2 - 2	0.822792333	0.769218398	0.107569895	0.13073760	5.583473e-01	0.899968333
69	8 - 2 - 3	0.093606782	0.099155151	0.061882146	0.66108614	2.430691e-02	0.246582877
70	8 - 3 - 1	0.001254936	0.005078008	0.005654057	4.50545361	2.176505e-04	0.014149804
71	8 - 3 - 2	0.142892487	0.156916663	0.069205316	0.48431739	5.239547e-02	0.319546029
72	8 - 3 - 3	0.855852667	0.838005322	0.070293593	0.08213282	6.714559e-01	0.942874900
73	9 - 1 - 1	0.861227500	0.853678462	0.074437974	0.08643242	6.751480e-01	0.958817600
74	9 - 1 - 2	0.136421415	0.141634627	0.073710639	0.54031575	3.894827e-02	0.315511465
75	9 - 1 - 3	0.002351138	0.004686900	0.005330335	2.26712981	1.838394e-04	0.018219450
76	9 - 2 - 1	0.094165580	0.128582048	0.064324897	0.68310414	4.060217e-02	0.247020550
77	9 - 2 - 2	0.812675567	0.777978936	0.088855358	0.10933681	5.831730e-01	0.902595933
78	9 - 2 - 3	0.093159383	0.093439011	0.059151530	0.63494978	2.012537e-02	0.237740317
79	9 - 3 - 1	0.001271442	0.004521670	0.004949413	3.89275501	2.387168e-04	0.013542587
80	9 - 3 - 2	0.143526060	0.155643897	0.062452241	0.43512823	5.673427e-02	0.299782155
81	9 - 3 - 3	0.855202467	0.839834426	0.063578382	0.07434308	6.941141e-01	0.938558233

Overall CV on movement
0.02535997

==========
GROWTH PARAMETER FITS
==========

	parameter	observed	expected	RMSE	CV	LR2.5	UP97.5
1	mu_Alpha	5.47	5.4109856	0.07917608	0.0144746	5.315060	5.518910

```
2   mu_Beta     2.89 2.8650199 2.60553815 0.9015703 2.779140 2.980870
3     theta     1.00 0.9897360 4.48030304 4.4803030 0.933575 1.000000
4     omega     0.80 0.8014311 4.66857149 5.8357144 0.791249 0.810212
```

g. Design scenario: 30% examination of commercial catch; 60000 tags released

```
Mean number of tags released
  stratum      Tags      Cost
1       1  9655.762 149206.79
2       2  6494.465  99679.15
3       3  4253.834  57560.00
4       4  8325.940 111519.57
5       5 15099.918 203127.00
6       6  8703.614 134531.09
7       7  5290.792  82276.63
8       8  3587.066  56483.45
      tot     Tags     Cost
1 Total   61411.39 894383.7

Mean number of fish examined
  stratum Fishexam     Cost
1       1 247013.0 211684.5
2       2 247055.8 211491.0
3       3 259480.1  94271.5
4       4 259521.2  94208.0
5       5 259475.7  94086.0
6       6 189997.8  92755.0
7       7 189431.1  92425.0
8       8 189469.0  92642.5
       tot    exam     Cost
1 Total    1841444 983563.5

Mean number of tags recovered
  stratum    Tags
1       1 125.908
2       2 128.206
3       3 141.203
4       4 145.634
5       5 151.863
6       6 102.308
7       7 102.165
8       8 102.133
       tot   tags
1 Total    999.42

======================================================================
POPULATION FITS
======================================================================

BY STRATUM & LENGTH

Total fits by length bin

   Numbers

   stock stratum length_bin   true_pop   exp_pop       RMSE        CV     LR2.5     UP97.5      bias
1      1       1          1  9819394.0 4734502.5  7642237.1 0.7782799  92393.47 15130691.9 0.4821583
2      1       1          2  1858781.0 1712406.2  1039648.2 0.5593172  90421.97  3913635.1 0.9212523
3      1       1          3  2720390.0 2631299.2  1166308.6 0.4287285 354442.45  5315725.0 0.9672507
4      1       1          4   853898.0  869102.7   618253.7 0.7240370  56462.54  2294856.3 1.0178062
5      1       1          5  1432697.0 1371956.4   859615.0 0.5999978  93677.13  3674136.7 0.9576040
6      1       1          6  1027808.0 1100561.5   795556.6 0.7740323  83263.05  3164277.9 1.0707851
7      1       1          7  1848468.0 1601963.9  1159302.7 0.6271695  92124.53  4044754.0 0.8666441
8      1       1          8   971744.0  775537.2   621941.8 0.6400264  46599.74  1975422.6 0.7980880
9      1       1          9  1038509.6  789586.3   553095.5 0.5325859  43654.39  1854688.9 0.7603072
10     1       2          1  7148476.0 6517751.4 11815929.3 1.6529298 472620.42 17287590.2 0.9117680
11     1       2          2  1442488.0 2419775.4  1685385.9 1.1683882 399686.17  5511855.3 1.6775013
12     1       2          3  1932185.0 3078475.3  1906703.2 0.9868119 623204.01  6353413.8 1.5932611
13     1       2          4   527582.0 1055212.3   910744.8 1.7262621 161448.84  2837240.4 2.0000915
14     1       2          5   848039.0 1771709.9  1367620.6 1.6126859 346372.10  4030915.7 2.0891844
15     1       2          6   662626.0 1464752.7  1212619.1 1.8300203 224275.48  3645999.9 2.2105271
16     1       2          7   847296.2 2126124.0  1843350.0 2.1755674 300315.32  5198366.5 2.5093043
17     1       2          8   322543.0  977447.8   941961.0 2.9204198 134624.92  2557017.0 3.0304417
18     1       2          9   397475.0  838099.1   716321.4 1.8021798 133644.71  2135856.4 2.1085579
19     2       3          1  4111469.0 3892024.5  4957819.2 1.2058510 206986.88 14083215.9 0.9466263
20     2       3          2   680678.0 1584555.7  1675833.2 2.4620058 161193.35  5232546.5 2.3279078
21     2       3          3  1011278.0 1934813.7  1750538.6 1.7310162 241302.89  5334489.8 1.9132362
```

22	2	3	4	375713.0	658202.1	662293.1	1.7627632	64006.92	2082691.9	1.7518747
23	2	3	5	733105.0	1151165.0	949776.2	1.2955528	143244.45	3193110.3	1.5702594
24	2	3	6	615578.0	979682.1	859109.9	1.3956150	102383.03	2924009.1	1.5914833
25	2	3	7	928584.0	1448965.3	1173941.8	1.2642279	183583.11	4097806.4	1.5604031
26	2	3	8	419288.5	773600.0	786209.5	1.8751038	75227.99	2763058.2	1.8450303
27	2	3	9	416626.9	663122.6	600293.1	1.4408410	79661.26	2040650.3	1.5916462
28	2	4	1	8545756.0	3899760.5	6153098.0	0.7200180	176244.78	13584929.4	0.4563389
29	2	4	2	1626135.0	1447748.3	1230746.4	0.7568537	115832.29	4595285.7	0.8903002
30	2	4	3	2285581.0	2110973.4	1338982.3	0.5858389	250277.18	5001487.8	0.9236047
31	2	4	4	686659.0	501596.4	475149.4	0.6919729	40698.64	1672450.8	0.7304883
32	2	4	5	1183629.0	893791.6	819324.7	0.6922142	69388.01	2787994.4	0.7551281
33	2	4	6	982014.0	720452.3	669587.7	0.6818515	57470.22	2321104.0	0.7336477
34	2	4	7	1416729.0	1065299.0	886506.8	0.6257420	83410.47	3073839.7	0.7519427
35	2	4	8	837158.0	577086.3	571445.0	0.6826012	39736.22	1889471.4	0.6893398
36	2	4	9	882732.6	615207.5	594498.0	0.6734747	44542.22	1823115.0	0.6969353
37	2	5	1	17152130.0	7852647.1	10797638.3	0.6295217	354104.24	19965317.0	0.4578234
38	2	5	2	3592000.0	3407184.1	1768926.7	0.4924629	414940.61	6973041.3	0.9485479
39	2	5	3	4465180.0	4044427.7	1900326.0	0.4255878	701481.63	8126202.4	0.9057704
40	2	5	4	1188960.0	1271424.1	724923.0	0.6097119	143437.41	2900060.1	1.0693582
41	2	5	5	1920851.0	2030334.7	1015863.1	0.5288609	325273.52	4392118.8	1.0569975
42	2	5	6	1454071.0	1522310.5	822844.5	0.5658901	210311.86	3275042.8	1.0469299
43	2	5	7	1856569.0	1940189.5	996644.1	0.5368204	324639.11	4207440.8	1.0450403
44	2	5	8	792360.0	860109.1	537479.6	0.6783276	91961.10	2201017.8	1.0855030
45	2	5	9	930555.8	893520.0	561513.4	0.6034172	99327.18	2256688.2	0.9602003
46	3	6	1	9399611.0	6638028.1	8987368.3	0.9561426	154287.01	25392970.5	0.7062024
47	3	6	2	2008033.0	1980266.6	1516221.2	0.7550778	145139.63	5438034.0	0.9861723
48	3	6	3	2755678.0	2911227.6	1552805.2	0.5634930	360107.11	6457440.8	1.0564469
49	3	6	4	726580.0	798172.7	700538.0	0.9641581	58827.58	2741706.4	1.0985338
50	3	6	5	1159637.0	1288182.0	949886.0	0.8191235	97968.91	3782980.5	1.1108494
51	3	6	6	816555.0	899874.6	743008.2	0.9099304	68950.36	2812215.4	1.1020379
52	3	6	7	1229585.0	1278650.7	864942.9	0.7034430	118261.30	3372779.6	1.0399043
53	3	6	8	560148.0	574650.5	455538.1	0.8132459	44420.29	1811437.1	1.0258904
54	3	6	9	576602.8	465777.5	425399.8	0.7377692	31471.38	1511421.9	0.8077961
55	3	7	1	5882663.0	5955966.1	14387711.7	2.4457821	183951.07	37617303.0	1.0124609
56	3	7	2	1126338.0	884318.9	696872.6	0.6187065	72279.10	2415121.3	0.7851275
57	3	7	3	1453034.0	1107025.4	735347.3	0.5060772	78752.81	2520089.1	0.7618716
58	3	7	4	419144.0	388655.1	379875.9	0.9063135	23862.83	1442452.6	0.9272591
59	3	7	5	709752.0	605159.3	486038.6	0.6848006	45206.77	1766188.4	0.8526349
60	3	7	6	458265.0	444924.4	403842.7	0.8812427	34489.48	1568406.8	0.9708890
61	3	7	7	547681.4	574407.7	472786.8	0.8632515	48730.20	1786005.9	1.0487989
62	3	7	8	334529.7	374174.6	373198.4	1.1155914	27353.64	1438186.2	1.1185094
63	3	7	9	501208.9	451926.9	443655.5	0.8851708	35871.56	1445368.5	0.9016737
64	3	8	1	3466915.0	7766675.8	27861880.9	8.0365053	156358.12	66910745.9	2.2402268
65	3	8	2	631414.0	680360.6	352428.1	0.5581570	184584.90	1626192.1	1.0775190
66	3	8	3	835650.0	858035.6	285912.9	0.3421443	395593.67	1580924.4	1.0267883
67	3	8	4	250608.0	340378.1	576931.6	2.3021276	39072.69	948523.1	1.3582094
68	3	8	5	399780.0	483071.1	297107.0	0.7431762	92963.18	1227485.9	1.2083425
69	3	8	6	341815.0	414382.4	289660.7	0.8474196	76030.11	1161728.4	1.2123002
70	3	8	7	597344.9	667946.1	405670.2	0.6791222	158459.70	1566995.9	1.1181917
71	3	8	8	396272.7	611449.5	1165959.5	2.9423159	55716.79	1862295.3	1.5430019
72	3	8	9	865307.8	1265455.7	1646651.8	1.9029667	225561.26	4536587.6	1.4624343

	biomass									
	stock	stratum	length_bin	true_bio	exp_bio	RMSE_bio	CV_bio	LR2.5	UP97.5	bias
2	1	1	2	704.7022	649.7608	394.3802	0.5596409	34.3	1486.0	0.9220360
3	1	1	3	1342.9958	1288.9394	572.2300	0.4260847	173.8	2602.0	0.9597494
4	1	1	4	509.3562	518.4266	368.7921	0.7240357	33.7	1368.9	1.0178075
5	1	1	5	977.2646	935.4430	586.1154	0.5997510	63.9	2504.9	0.9572054
6	1	1	6	831.0901	891.4220	644.5317	0.7755256	67.4	2563.0	1.0725936
7	1	1	7	1961.7952	1689.5475	1225.7365	0.6248035	97.0	4259.7	0.8612252
8	1	1	8	1473.8963	1171.1529	941.2071	0.6385844	70.5	2987.6	0.7945966
9	1	1	9	3090.5890	2080.3607	1647.0258	0.5329165	115.8	4902.3	0.6731276
11	1	2	2	546.1504	918.1769	640.1865	1.1721798	151.6	2090.5	1.6811796
12	1	2	3	949.1864	1508.0613	932.4362	0.9823531	305.4	3109.5	1.5887936
13	1	2	4	314.7064	629.4421	543.2651	1.7262601	96.3	1692.4	2.0000930
14	1	2	5	578.4150	1207.9913	932.3351	1.6118791	236.2	2749.4	2.0884508
15	1	2	6	536.2641	1186.3775	982.4543	1.8320344	181.7	2952.8	2.2123007
16	1	2	7	877.9498	2242.1826	1954.8816	2.2266440	317.5	5469.9	2.5538848
17	1	2	8	490.2926	1475.7793	1419.7618	2.8957437	202.8	3864.4	3.0099969
18	1	2	9	1223.0119	2210.3815	1785.3258	1.4597780	356.4	5606.0	1.8073263
20	2	3	2	257.9074	601.7497	636.7173	2.4687828	61.3	1988.3	2.3332009
21	2	3	3	500.8869	948.7371	855.6921	1.7083539	118.3	2612.0	1.8941143
22	2	3	4	224.1155	392.6201	395.0605	1.7627541	38.2	1242.3	1.7518652
23	2	3	5	500.9594	784.9074	647.1585	1.2918383	97.6	2178.0	1.5668084
24	2	3	6	498.4988	793.1784	695.5110	1.3952109	82.9	2367.4	1.5911339
25	2	3	7	973.0501	1518.9723	1230.7480	1.2648352	192.4	4296.5	1.5610422
26	2	3	8	628.6183	1170.1430	1191.7905	1.8958888	114.0	4173.1	1.8614522
27	2	3	9	1330.7216	1767.5852	1522.4429	1.1440732	211.6	5416.2	1.3282908
29	2	4	2	617.2185	549.7503	467.2864	0.7570844	44.0	1745.4	0.8906900
30	2	4	3	1123.7044	1035.1658	657.0389	0.5847080	122.7	2451.0	0.9212082
31	2	4	4	409.5970	299.2063	283.4286	0.6919695	24.3	997.6	0.7304895
32	2	4	5	807.8594	609.4116	558.9209	0.6918542	47.3	1900.6	0.7543535

33	2	4	6	795.8706	583.3151	542.4321	0.6815582	46.5	1878.7	0.7329271
34	2	4	7	1485.0560	1116.8979	929.4043	0.6258379	87.1	3229.0	0.7520915
35	2	4	8	1270.8213	873.0092	866.4534	0.6818058	60.0	2866.4	0.6869646
36	2	4	9	2520.8990	1639.8063	1667.5580	0.6614934	119.1	4817.8	0.6504847
38	2	5	2	1361.1085	1293.8376	671.4156	0.4932859	157.6	2649.2	0.9505764
39	2	5	3	2188.2372	1983.2688	931.4452	0.4256601	344.0	3990.5	0.9063317
40	2	5	4	709.2231	758.4130	432.4219	0.6097121	85.6	1729.9	1.0693575
41	2	5	5	1311.2956	1384.3384	692.4536	0.5280683	221.8	2994.7	1.0557027
42	2	5	6	1176.7196	1232.5085	666.2789	0.5662172	170.3	2649.1	1.0474105
43	2	5	7	1937.3720	2033.9394	1045.5731	0.5396863	341.0	4393.8	1.0498445
44	2	5	8	1187.4878	1300.9089	814.3661	0.6857890	138.7	3324.4	1.0955135
45	2	5	9	3263.9906	2382.8791	1734.2596	0.5313311	263.6	5968.9	0.7300508
47	3	6	2	761.2854	751.1464	575.0298	0.7553406	55.1	2062.6	0.9866817
48	3	6	3	1352.8026	1425.4816	759.8591	0.5616925	176.3	3156.6	1.0537247
49	3	6	4	433.4101	476.1170	417.8762	0.9641589	35.1	1635.4	1.0985369
50	3	6	5	790.4542	877.9983	647.4216	0.8190502	66.8	2576.9	1.1107516
51	3	6	6	660.4672	728.5730	601.6189	0.9108990	55.8	2275.1	1.1031176
52	3	6	7	1291.9545	1341.5475	906.9424	0.7019925	124.4	3533.9	1.0383860
53	3	6	8	838.3143	865.9770	686.5207	0.8189300	67.1	2736.0	1.0329980
54	3	6	9	2050.4870	1259.9957	1363.9300	0.6651737	85.6	4103.0	0.6144861
56	3	7	2	426.2993	335.4415	264.0350	0.6193653	27.4	916.3	0.7868685
57	3	7	3	713.8823	542.0686	361.2035	0.5059706	38.6	1233.2	0.7593249
58	3	7	4	250.0224	231.8347	226.5975	0.9063089	14.2	860.4	0.9272558
59	3	7	5	483.7935	412.4603	331.2799	0.6847548	30.8	1204.2	0.8525545
60	3	7	6	369.9720	360.2259	326.9134	0.8836166	27.9	1269.8	0.9736573
61	3	7	7	575.7413	602.7218	496.0862	0.8616478	51.1	1876.9	1.0468622
62	3	7	8	512.7729	564.0297	561.9230	1.0958518	41.3	2165.8	1.0999601
63	3	7	9	1661.4012	1220.3286	1262.4415	0.7598655	96.4	3885.3	0.7345177
65	3	8	2	239.2613	258.0733	133.7119	0.5588533	70.0	616.3	1.0786255
66	3	8	3	411.2117	420.1387	139.8689	0.3401383	193.8	774.3	1.0217090
67	3	8	4	149.4895	203.0389	344.1426	2.3021196	23.3	565.8	1.3582156
68	3	8	5	273.0141	329.2413	202.3363	0.7411204	63.4	836.0	1.2059497
69	3	8	6	277.1222	335.4915	234.3875	0.8457910	61.5	941.1	1.2106265
70	3	8	7	628.7998	700.7009	425.0279	0.6759352	166.3	1646.8	1.1143465
71	3	8	8	606.2867	921.3592	1753.2329	2.8917557	84.6	2800.4	1.5196759
72	3	8	9	2830.4974	3427.4554	4363.9091	1.5417464	609.4	12079.5	1.2109022

BY STOCK & LENGTH

Total fits by length bin

numbers

	stock	length_bin	true_pop	exp_pop	RMSE	CV	bias
1	1	1	16967870	11252254	14071957.0	0.8293296	0.6631506
4	1	2	3301269	4132182	1980251.1	0.5998454	1.2516949
7	1	3	4652575	5709774	2235127.0	0.4804064	1.2272289
10	1	4	1381480	1924315	1100769.6	0.7968046	1.3929373
13	1	5	2280736	3143666	1615340.2	0.7082539	1.3783561
16	1	6	1690434	2565314	1450294.9	0.8579423	1.5175477
19	1	7	2695764	3728088	2177595.5	0.8077841	1.3829428
22	1	8	1294287	1752985	1128761.3	0.8721105	1.3544020
25	1	9	1435985	1627685	905003.4	0.6302320	1.1334978
2	2	1	29809355	15644432	13380193.6	0.4488589	0.5248162
5	2	2	5898813	6439488	2729881.9	0.4627850	1.0916583
8	2	3	7762039	8090215	2910068.3	0.3749103	1.0422796
11	2	4	2251332	2431223	1090831.1	0.4845270	1.0799041
14	2	5	3837585	4075291	1614108.3	0.4206052	1.0619416
17	2	6	3051663	3222445	1365097.2	0.4473290	1.0559635
20	2	7	4201882	4454454	1776888.6	0.4228792	1.0601092
23	2	8	2048807	2210795	1110657.0	0.5420995	1.0790650
26	2	9	2229915	2171850	1014434.3	0.4549206	0.9739608
3	3	1	18749189	20360670	32619985.4	1.7398078	1.0859494
6	3	2	3765785	3544946	1705509.8	0.4528962	0.9413565
9	3	3	5044362	4876289	1741747.9	0.3452861	0.9666809
12	3	4	1396332	1527206	983823.8	0.7045772	1.0937269
15	3	5	2269169	2376413	1107605.3	0.4881105	1.0472611
18	3	6	1616635	1759181	893897.9	0.5529374	1.0881748
21	3	7	2374611	2521004	1065937.1	0.4488891	1.0616493
24	3	8	1290950	1560275	1306236.4	1.0118409	1.2086248
27	3	9	1943119	2183160	1757628.4	0.9045395	1.1235336

biomass

	stock	length_bin	true_bio	exp_bio	RMSE	CV	bias
1	1	2	1250.8526	1567.9377	751.9139	0.6011211	1.2534952
4	1	3	2292.1822	2797.0007	1094.0221	0.4772841	1.2202349

```
7      1          4  824.0626 1147.8687  656.6160 0.7968036 1.3929387
10     1          5 1555.6796 2143.4343 1101.2629 0.7078983 1.3778122
13     1          6 1367.3543 2077.7995 1175.0054 0.8593277 1.5195766
16     1          7 2839.7450 3931.7301 2307.3777 0.8125299 1.3845363
19     1          8 1964.1889 2646.9322 1703.4067 0.8672316 1.3475955
22     1          9 4313.6008 4290.7422 2429.0085 0.5631046 0.9947008
2      2          2 2236.2343 2445.3376 1036.6120 0.4635525 1.0935069
5      2          3 3812.8285 3967.1717 1425.3068 0.3738187 1.0404800
8      2          4 1342.9355 1450.2394  650.6867 0.4845257 1.0799025
11     2          5 2620.1145 2778.6574 1100.3176 0.4199502 1.0605099
14     2          6 2471.0890 2609.0020 1105.3939 0.4473307 1.0558106
17     2          7 4395.4781 4669.8096 1863.2649 0.4239049 1.0624122
20     2          8 3086.9274 3344.0611 1683.5374 0.5453764 1.0832976
23     2          9 7115.6112 5790.2706 2847.1457 0.4001266 0.8137419
3      3          2 1426.8460 1344.6612  646.7245 0.4532546 0.9424011
6      3          3 2477.8967 2387.6889  852.8875 0.3441982 0.9635950
9      3          4  832.9220  910.9906  586.8570 0.7045762 1.0937286
12     3          5 1547.2618 1619.6999  754.8782 0.4878801 1.0468169
15     3          6 1307.5613 1424.2904  723.7093 0.5534802 1.0892723
18     3          7 2496.4956 2644.9702 1117.7185 0.4477150 1.0594732
21     3          8 1957.3738 2351.3659 1964.9157 1.0038531 1.2012861
24     3          9 6542.3856 5907.7797 4743.1810 0.7249926 0.9030008
```

```
STRATUM FITS +25cm
   numbers
  stratum true_pop  exp_pop    RMSE        CV      bias
1       1 11752296 10852413 2496385 0.2124168 0.9234292
2       2  6980234 13731596 3929971 0.5630143 1.9672114
3       3  5180851  9194106 3210638 0.6197124 1.7746324
4       4  9900638  7932155 2473639 0.2498464 0.8011762
5       5 16200547 15969500 3251521 0.2007044 0.9857383
6       6  9832819 10196802 2791386 0.2838846 1.0370172
7       7  5549953  4830592 1459325 0.2629437 0.8703844
8       8  4318192  5321079 2224066 0.5150456 1.2322469

   biomass
  stratum  true_bio   exp_bio     RMSE        CV      bias
1       1 10891.689  9225.053 2545.376 0.2336989 0.8469809
2       2  5515.977 11378.392 3526.124 0.6392566 2.0628065
3       3  4914.758  7977.893 2729.318 0.5553311 1.6232525
4       4  9031.026  6706.562 2394.222 0.2651107 0.7426136
5       5 13135.434 12370.094 2681.952 0.2041769 0.9417346
6       6  8179.175  7726.836 2240.073 0.2738751 0.9446963
7       7  4993.885  4269.111 1619.804 0.3243575 0.8548678
8       8  5415.683  6595.499 4748.677 0.8768381 1.2178519
```

```
STOCK FITS +25cm
   numbers
  stock true_pop  exp_pop    RMSE        CV     bias
1     1 18732530 24584010 4655815 0.2485417 1.312370
2     2 31282036 33095761 5196101 0.1661050 1.057980
3     3 19700964 20348474 3855896 0.1957212 1.032867

   biomass
  stock true_bio  exp_bio     RMSE        CV      bias
1     1 16407.67 20603.45 4348.849 0.2650498 1.2557207
2     2 27081.22 27054.55 4513.795 0.1666762 0.9990152
3     3 18588.74 18591.45 5494.690 0.2955924 1.0001455
```

```
SNA 1 FITS (25 cm +)
   numbers
  true_pop  exp_pop    RMSE        CV     bias
1 69715530 78028244 7971450 0.1143425 1.119238

   biomass
```

```
  true_bio  exp_bio     RMSE        CV     bias
1 62077.63 66249.44 8335.374 0.1342734 1.067203
```

```
=====================================================================
TAG RECOVERY FITS
=====================================================================
   release recovery TagObs      TagExp       RMSE           CV
1        1        1 86.133 87.79489147 3.45414419   0.04010245
2        1        2 46.596 42.30666422 6.51788980   0.13988089
3        1        3 16.461 16.53024694 2.76883259   0.16820561
4        1        4  1.735  2.06728633 1.07075715   0.61715110
5        1        5  0.243  0.34915631 0.46192093   1.90090917
6        1        6  0.041  0.12449572 0.24881458   6.06864832
7        1        7  0.017  0.04626511 0.14920219   8.77659930
8        1        8  0.001  0.03231364 0.14885136 148.85135665
9        2        1 31.048 33.27664415 5.01698800   0.16158812
10       2        2 52.139 49.51235803 4.95167006   0.09497056
11       2        3 31.830 28.52064516 5.43052419   0.17061025
12       2        4  5.350  6.22248951 2.17195458   0.40597282
13       2        5  1.107  1.43662896 1.02986869   0.93032402
14       2        6  0.239  0.42942915 0.47681240   1.99503097
15       2        7  0.059  0.54653276 0.59078839  10.01336248
16       2        8  0.012  0.13139588 0.19504278  16.25356460
17       3        1  6.891  9.20365942 3.26171698   0.47332999
18       3        2 19.994 20.03939123 3.86468100   0.19329204
19       3        3 36.872 39.39211082 4.23010686   0.11472410
20       3        4 17.097 21.41155504 5.73018358   0.33515725
21       3        5  4.892  7.28467747 3.20924122   0.65601824
22       3        6  1.211  1.83679500 1.25129195   1.03327163
23       3        7  0.328  0.54821118 0.56275717   1.71572309
24       3        8  0.083  0.34115124 0.39060435   4.70607652
25       4        1  1.420  1.49984349 0.98214947   0.69165456
26       4        2  6.431  5.55728663 2.23776035   0.34796460
27       4        3 33.730 27.68868111 7.32259625   0.21709446
28       4        4 61.494 61.73941333 3.18835356   0.05184821
29       4        5 26.000 25.71879876 4.39744361   0.16913245
30       4        6  7.011  7.42157545 2.16278728   0.30848485
31       4        7  2.023  2.23349335 1.13153954   0.55933739
32       4        8  0.434  1.23862420 1.05626745   2.43379597
33       5        1  0.344  0.46706453 0.54271769   1.57766770
34       5        2  2.499  2.31170211 1.10266354   0.44124191
35       5        3 17.986 17.02035814 3.04234972   0.16915099
36       5        4 47.615 46.68230812 4.85746969   0.10201553
37       5        5 89.124 88.73534588 4.07714304   0.04574686
38       5        6 30.524 30.82984621 4.25334962   0.13934444
39       5        7  9.378 10.03691541 2.28454335   0.24360667
40       5        8  2.084  2.48052938 1.17638316   0.56448328
41       6        1  0.060  0.12198102 0.26352206   4.39203438
42       6        2  0.463  0.53775686 0.55254140   1.19339395
43       6        3  3.683  3.32788941 1.39037287   0.37751096
44       6        4 10.267 10.43648228 2.46869910   0.24044990
45       6        5 25.127 24.29190338 4.01028128   0.15960048
46       6        6 48.037 46.94997277 3.41141045   0.07101631
47       6        7 21.503 21.56359787 3.28518103   0.15277780
48       6        8  5.327  5.33677444 1.62030832   0.30416901
49       7        1  0.011  0.02645881 0.09962118   9.05647084
50       7        2  0.071  0.41854723 0.46480294   6.54652026
51       7        3  0.553  0.59601025 0.59167889   1.06994374
52       7        4  1.804  1.89488090 1.10242754   0.61110174
53       7        5  4.675  4.78530201 1.89463111   0.40526869
54       7        6 13.065 13.09466100 3.10616443   0.23774699
55       7        7 53.762 54.21293662 2.32955235   0.04333083
56       7        8 22.552 22.50752568 3.36029415   0.14900205
57       8        1  0.001  0.01254685 0.06630549  66.30548893
58       8        2  0.013  0.06781529 0.12949538   9.96118295
59       8        3  0.088  0.24810139 0.33023828   3.75270778
60       8        4  0.272  0.70882790 0.66541542   2.44638022
61       8        5  0.695  0.78688471 0.75787199   1.09046329
62       8        6  2.180  2.19124964 1.31761059   0.60440853
63       8        7 15.095 15.24184183 3.29732713   0.21843837
64       8        8 71.640 68.79453945 3.55884930   0.04967685
```

	rec_stra	Length_bin	TagObs	TagExp	RMSE	CV
1	1	1	6.099	6.600077	1.5669795	0.25692401
2	1	2	19.860	20.915982	2.6588381	0.13387906
3	1	3	33.309	34.899395	3.4966939	0.10497745
4	1	4	8.016	8.508325	1.7168183	0.21417395
5	1	5	13.716	14.468638	2.1720138	0.15835621
6	1	6	9.041	9.453826	1.6107519	0.17816081
7	1	7	14.094	14.697202	2.1797914	0.15466095
8	1	8	8.839	9.262542	1.8373197	0.20786511
9	1	9	12.934	13.597103	2.1444471	0.16579922
10	2	1	6.632	6.253837	1.8299586	0.27592863
11	2	2	19.380	18.395850	3.1946295	0.16484156
12	2	3	33.546	31.971922	4.2738876	0.12740379
13	2	4	8.410	7.929018	2.1118547	0.25111233
14	2	5	14.369	13.297125	2.8388169	0.19756538
15	2	6	9.248	8.605058	2.2311392	0.24125640
16	2	7	14.614	13.689033	2.7852331	0.19058664
17	2	8	8.965	8.390197	2.2479247	0.25074453
18	2	9	13.042	12.219483	2.5686923	0.19695540
19	3	1	7.918	7.389372	2.1295200	0.26894670
20	3	2	19.666	18.296929	3.6793854	0.18709374
21	3	3	37.070	34.873060	5.1249961	0.13825185
22	3	4	10.792	9.987779	2.4348837	0.22561932
23	3	5	17.265	16.408742	2.8728086	0.16639494
24	3	6	11.559	11.063787	2.4028922	0.20788063
25	3	7	16.703	15.986827	2.9021271	0.17374885
26	3	8	9.252	8.803781	2.2234881	0.24032513
27	3	9	10.978	10.513767	2.4595053	0.22403947
28	4	1	8.694	8.686485	2.0982633	0.24134613
29	4	2	18.659	19.316909	2.9974751	0.16064500
30	4	3	36.727	37.426297	4.4809982	0.12200828
31	4	4	11.210	11.669472	2.2952269	0.20474817
32	4	5	18.488	19.407302	3.1227646	0.16890765
33	4	6	13.015	13.620059	2.3947975	0.18400288
34	4	7	19.106	19.959787	2.9300678	0.15335851
35	4	8	9.677	10.254867	2.1592152	0.22312857
36	4	9	10.058	10.822067	2.2921589	0.22789410
37	5	1	7.617	7.845949	1.8748263	0.24613710
38	5	2	18.044	18.270958	2.9251583	0.16211252
39	5	3	35.419	36.465138	4.3349774	0.12239130
40	5	4	11.050	11.168027	2.2464657	0.20330006
41	5	5	19.102	19.240309	2.8773419	0.15063040
42	5	6	14.226	14.154333	2.3975805	0.16853511
43	5	7	21.812	21.795347	2.9554697	0.13549742
44	5	8	11.991	11.866648	2.1702422	0.18098926
45	5	9	12.602	12.581989	2.2228642	0.17638979
46	6	1	4.871	5.044018	1.6017365	0.32883114
47	6	2	14.167	14.354013	2.6650169	0.18811442
48	6	3	26.157	25.970253	3.5331558	0.13507496
49	6	4	6.799	7.012747	1.9007244	0.27955941
50	6	5	12.114	12.092241	2.4650754	0.20348980
51	6	6	8.436	8.605268	2.0482216	0.24279535
52	6	7	13.458	13.620804	2.6208151	0.19474031
53	6	8	7.208	7.320265	1.8448403	0.25594344
54	6	9	9.098	8.858416	1.8609121	0.20454079
55	7	1	3.716	3.741960	1.2126791	0.32633991
56	7	2	15.599	16.066268	2.4880137	0.15949828
57	7	3	28.535	29.945078	3.7548270	0.13158672
58	7	4	6.961	7.143840	1.6718250	0.24017023
59	7	5	12.018	12.367042	2.1945058	0.18260158
60	7	6	8.612	8.672192	1.7733141	0.20591200
61	7	7	13.908	13.867401	2.3383783	0.16813189
62	7	8	6.616	6.502067	1.5943205	0.24097952
63	7	9	6.200	6.123946	1.4780277	0.23839157
64	8	1	3.588	3.542336	0.8977428	0.25020703
65	8	2	17.327	17.081598	1.8619429	0.10745904
66	8	3	32.666	31.883103	2.5361161	0.07763779
67	8	4	7.504	7.281832	1.2026634	0.16026964
68	8	5	12.790	12.567241	1.5914233	0.12442716
69	8	6	8.284	8.225045	1.2895179	0.15566368
70	8	7	11.638	11.698989	1.7087625	0.14682613
71	8	8	4.801	4.904337	1.0661000	0.22205791
72	8	9	3.535	3.678373	1.0724871	0.30339098

	TagObs	TagExp	RMSE	CV
1	999.42	999.2013	21.26624	0.02127858

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PROPORTIONAL MOVEMENT FITS
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	Lb__Fr__To	true_mm	geo_obs	RMSE	CV	LR2.5	UP97.5
1	1 - 1 - 1	0.858749000	0.797132490	0.212039979	0.24691729	6.141100e-02	0.97068180
2	1 - 1 - 2	0.139050975	0.164747355	0.151947771	1.09274869	1.530627e-02	0.68199380
3	1 - 1 - 3	0.002199921	0.038120147	0.152766103	69.44162173	6.886783e-06	0.67227371
4	1 - 2 - 1	0.150323860	0.159959218	0.087969809	0.58520190	2.017488e-02	0.35131080
5	1 - 2 - 2	0.738555933	0.669847536	0.202790538	0.27457709	1.076331e-01	0.90467833
6	1 - 2 - 3	0.111120437	0.170193246	0.174105296	1.56681616	1.422536e-02	0.64475813
7	1 - 3 - 1	0.001321854	0.008088254	0.045760722	34.61858732	2.536666e-05	0.01993465
8	1 - 3 - 2	0.177218823	0.165972499	0.103053111	0.58150206	1.851375e-02	0.39541292
9	1 - 3 - 3	0.821458933	0.825939239	0.109212610	0.13294957	5.890313e-01	0.97441457
10	2 - 1 - 1	0.863663500	0.822792254	0.134178694	0.15535992	4.678376e-01	0.96114850
11	2 - 1 - 2	0.134116670	0.172982291	0.132879688	0.99077682	3.600783e-02	0.52291878
12	2 - 1 - 3	0.002220054	0.004225445	0.004619632	2.08086433	3.798472e-05	0.01454933
13	2 - 2 - 1	0.171122367	0.164641419	0.064716581	0.37818891	5.492219e-02	0.29499433
14	2 - 2 - 2	0.711572533	0.718555137	0.107418117	0.15095877	4.622534e-01	0.87779987
15	2 - 2 - 3	0.117304604	0.116803429	0.079911897	0.68123411	2.363482e-02	0.32338519
16	2 - 3 - 1	0.001286535	0.004515257	0.004632612	3.60084451	1.561899e-04	0.01339945
17	2 - 3 - 2	0.180456522	0.190185096	0.078845924	0.43692477	6.779234e-02	0.36772283
18	2 - 3 - 3	0.818257233	0.805299644	0.079590710	0.09726857	6.229971e-01	0.92938200
19	3 - 1 - 1	0.864165500	0.840381094	0.093782904	0.10852424	6.316550e-01	0.95765100
20	3 - 1 - 2	0.133691885	0.155621519	0.092638798	0.69292761	3.872893e-02	0.36373202
21	3 - 1 - 3	0.002142748	0.003997395	0.003780460	1.76430455	1.050385e-04	0.01209282
22	3 - 2 - 1	0.158601927	0.159462714	0.053715563	0.33868165	6.590316e-02	0.26370810
23	3 - 2 - 2	0.727094067	0.720609914	0.081466861	0.11204446	5.336543e-01	0.85160073
24	3 - 2 - 3	0.114303678	0.119927369	0.059240121	0.51826960	3.762120e-02	0.28245529
25	3 - 3 - 1	0.001250112	0.004199469	0.003975175	3.17985568	3.102241e-04	0.01077369
26	3 - 3 - 2	0.170413280	0.171441550	0.056855865	0.33363518	7.855640e-02	0.29715753
27	3 - 3 - 3	0.828336333	0.824358997	0.057394876	0.06928934	6.881315e-01	0.91616550
28	4 - 1 - 1	0.856559500	0.848258775	0.097966911	0.11437257	6.250095e-01	0.96498500
29	4 - 1 - 2	0.141295110	0.146377039	0.094033093	0.66550847	3.005466e-02	0.36685438
30	4 - 1 - 3	0.002145239	0.005364191	0.030066300	14.01536460	2.291385e-05	0.01887684
31	4 - 2 - 1	0.131129173	0.159611569	0.079763978	0.60828553	4.551445e-02	0.33226652
32	4 - 2 - 2	0.761521600	0.722825663	0.124239959	0.16314699	4.081257e-01	0.88311120
33	4 - 2 - 3	0.107349127	0.117562767	0.087604437	0.81607032	2.426967e-02	0.35211710
34	4 - 3 - 1	0.001289106	0.005064793	0.007674103	5.95304188	9.655774e-05	0.01723813
35	4 - 3 - 2	0.166752871	0.177822654	0.079967792	0.47955872	5.440855e-02	0.36092391
36	4 - 3 - 3	0.831958100	0.817112549	0.081315830	0.09774029	6.295178e-01	0.94190090
37	5 - 1 - 1	0.846992500	0.844223741	0.085202127	0.10059372	6.468216e-01	0.95754800
38	5 - 1 - 2	0.150806710	0.151607131	0.084501403	0.56032920	3.864575e-02	0.34444594
39	5 - 1 - 3	0.002200553	0.004169142	0.004471640	2.03205337	5.845619e-05	0.01393579
40	5 - 2 - 1	0.118294067	0.154456070	0.075709293	0.64000922	5.543580e-02	0.30514653
41	5 - 2 - 2	0.777935800	0.732891263	0.112399781	0.14448465	4.625175e-01	0.87191857
42	5 - 2 - 3	0.103770180	0.112652660	0.073976873	0.71289144	2.436280e-02	0.32848423
43	5 - 3 - 1	0.001322451	0.004959716	0.005266882	3.98266652	2.389262e-04	0.01498379
44	5 - 3 - 2	0.165961482	0.175598148	0.070993252	0.42776945	6.457223e-02	0.33853067
45	5 - 3 - 3	0.832716167	0.819442135	0.072353227	0.08688822	6.505170e-01	0.93159980
46	6 - 1 - 1	0.837647500	0.841635667	0.092887575	0.11089101	6.180115e-01	0.96132300
47	6 - 1 - 2	0.160107570	0.154247644	0.092072737	0.57506798	3.536829e-02	0.37421232
48	6 - 1 - 3	0.002245003	0.004116690	0.005770750	2.57048687	2.819074e-05	0.01555121
49	6 - 2 - 1	0.114179020	0.156415387	0.087079331	0.76265615	4.390125e-02	0.33002346
50	6 - 2 - 2	0.786978667	0.736041725	0.125825051	0.15988369	4.593324e-01	0.89853747
51	6 - 2 - 3	0.098842144	0.107542896	0.076183973	0.77076407	2.251418e-02	0.30161611
52	6 - 3 - 1	0.001487237	0.005382174	0.006662412	4.47972579	9.642657e-05	0.01806443
53	6 - 3 - 2	0.175610207	0.182164442	0.077625982	0.44203571	5.449384e-02	0.35678162
54	6 - 3 - 3	0.822902233	0.812453384	0.078532946	0.09543411	6.385839e-01	0.94032137
55	7 - 1 - 1	0.844123500	0.843305527	0.091585248	0.10849745	6.297600e-01	0.95618800
56	7 - 1 - 2	0.153662120	0.152784011	0.090356173	0.58801852	4.179712e-02	0.36870748
57	7 - 1 - 3	0.002214117	0.003910468	0.005280567	2.38495391	9.101217e-05	0.01462171
58	7 - 2 - 1	0.102319653	0.146760543	0.085954160	0.84005523	4.527727e-02	0.32109338
59	7 - 2 - 2	0.798281833	0.746395367	0.113752350	0.14249648	5.090638e-01	0.88430663
60	7 - 2 - 3	0.099398652	0.106844101	0.063995497	0.64382661	2.626948e-02	0.27803653
61	7 - 3 - 1	0.001373821	0.005534398	0.016511178	12.01843114	2.633154e-04	0.01562785
62	7 - 3 - 2	0.163432494	0.170643961	0.071109083	0.43509758	6.355742e-02	0.34295422
63	7 - 3 - 3	0.835193300	0.823821643	0.073836709	0.08840673	6.525810e-01	0.93147637
64	8 - 1 - 1	0.852767500	0.838777974	0.103541881	0.12141865	6.095730e-01	0.96958850
65	8 - 1 - 2	0.144710545	0.156056056	0.102339495	0.70720136	2.711618e-02	0.38258207
66	8 - 1 - 3	0.002522037	0.005165965	0.012533723	4.96968242	4.237479e-05	0.01944941
67	8 - 2 - 1	0.083600687	0.138874823	0.092042106	1.10097309	3.643423e-02	0.30615171

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68  8 - 2 - 2 0.822792333 0.756368072 0.127668197  0.15516454 4.800149e-01 0.90344833
69  8 - 2 - 3 0.093606782 0.104757116 0.071677274  0.76572736 2.028220e-02 0.30462044
70  8 - 3 - 1 0.001254936 0.005033381 0.008505498  6.77763358 1.023638e-04 0.01588521
71  8 - 3 - 2 0.142892487 0.155364170 0.083514621  0.58445775 3.333133e-02 0.36689719
72  8 - 3 - 3 0.855852667 0.839602448 0.085428923  0.09981732 6.212515e-01 0.95880107
73  9 - 1 - 1 0.861227500 0.846073120 0.091812017  0.10660600 6.406900e-01 0.96543015
74  9 - 1 - 2 0.136421415 0.148899057 0.090925547  0.66650494 3.144195e-02 0.35512247
75  9 - 1 - 3 0.002351138 0.005027821 0.006823074  2.90203032 4.351229e-05 0.02202655
76  9 - 2 - 1 0.094165580 0.132050548 0.073468565  0.78020615 3.937703e-02 0.28032189
77  9 - 2 - 2 0.812675567 0.770191864 0.111374101  0.13704620 5.204528e-01 0.91144587
78  9 - 2 - 3 0.093159383 0.097757590 0.076537474  0.82157557 1.817211e-02 0.29592128
79  9 - 3 - 1 0.001271442 0.004475451 0.005044366  3.96743639 7.643498e-05 0.01421460
80  9 - 3 - 2 0.143526060 0.155222007 0.070576334  0.49173184 3.993758e-02 0.30796393
81  9 - 3 - 3 0.855202467 0.840302537 0.071281708  0.08335068 6.872134e-01 0.95620160


Overall CV on movement
0.02961701


=====================================================================
GROWTH PARAMETER FITS
=====================================================================
  parameter observed  expected      RMSE         CV    LR2.5   UP97.5
1  mu_Alpha     5.47 5.4111253 0.0844746 0.01544325 5.298880 5.531150
2   mu_Beta     2.89 2.8683195 2.6024491 0.90050141 2.761070 2.999610
3     theta     1.00 0.9884773 4.4815805 4.48158046 0.920150 1.000000
4     omega     0.80 0.8013107 4.6686925 5.83586566 0.789689 0.811238
```

h. Design scenario: 60% examination of commercial catch; 60000 tags released

```
Mean number of tags released
  stratum      Tags      Cost
1       1  9659.735 148689.95
2       2  6495.098  99638.54
3       3  4257.752  57489.51
4       4  8316.965 112041.90
5       5 15104.810 202636.68
6       6  8700.358 135292.82
7       7  5294.302  82304.41
8       8  3590.256  55946.52
      tot     Tags     Cost
1 Total   61419.28 894040.3

Mean number of fish examined
  stratum Fishexam     Cost
1       1 452811.7 409000.5
2       2 453518.5 408690.0
3       3 468750.6 171501.5
4       4 468532.6 171407.0
5       5 467798.8 171235.5
6       6 336944.3 170792.5
7       7 336800.4 170722.0
8       8 336845.9 170531.0
       tot    exam    Cost
1 Total    3322003 1843880

Mean number of tags recovered
  stratum    Tags
1       1 230.941
2       2 235.170
3       3 256.490
4       4 264.155
5       5 275.261
6       6 181.730
7       7 181.725
8       8 181.508
       tot    tags
1 Total    1806.98

=====================================================================
POPULATION FITS
=====================================================================

BY STRATUM & LENGTH
```

Total fits by length bin

Numbers

	stock	stratum	length_bin	true_pop	exp_pop	RMSE	CV	LR2.5	UP97.5	bias
1	1	1	1	9819394.0	4581979.4	7179740.0	0.7311795	118309.10	11890795.8	0.4666255
2	1	1	2	1858781.0	1736952.6	795615.9	0.4280310	183197.61	3478742.3	0.9344579
3	1	1	3	2720390.0	2493041.1	839112.3	0.3084529	589020.87	4020849.4	0.9164278
4	1	1	4	853898.0	809510.2	440368.4	0.5157154	86653.16	1805483.4	0.9480174
5	1	1	5	1432697.0	1300982.4	744503.4	0.5196517	119114.13	2615611.2	0.9080653
6	1	1	6	1027808.0	1039190.4	555569.2	0.5405379	135411.42	2401534.1	1.0110744
7	1	1	7	1848468.0	1625823.5	863338.7	0.4670563	133542.15	3331190.9	0.8795519
8	1	1	8	971744.0	798909.8	481832.3	0.4958428	69637.83	1703206.2	0.8221402
9	1	1	9	1038509.6	793431.1	456578.9	0.4396483	77052.34	1532403.2	0.7640094
10	1	2	1	7148476.0	5944732.6	4399784.4	0.6154856	602692.23	14110907.6	0.8316084
11	1	2	2	1442488.0	2361950.0	1416509.0	0.9819902	695734.40	4844614.7	1.6374140
12	1	2	3	1932185.0	3237789.2	1822660.0	0.9433155	1062807.21	6249053.6	1.6757139
13	1	2	4	527582.0	1012372.4	721703.3	1.3679454	206556.47	2185228.4	1.9188911
14	1	2	5	848039.0	1763093.8	1299410.0	1.5322527	427078.89	3675250.7	2.0790245
15	1	2	6	662626.0	1412534.4	1050966.3	1.5860626	314713.73	3112108.6	2.1317220
16	1	2	7	847296.2	1996545.8	1620298.9	1.9123169	425648.68	4488628.5	2.3563729
17	1	2	8	322543.0	871287.1	768484.7	2.3825806	163831.02	2091044.4	2.7013054
18	1	2	9	397475.0	771963.0	578619.9	1.4557389	157013.90	1770373.6	1.9421675
19	2	3	1	4111469.0	3373217.9	3250038.8	0.7904812	318494.82	11677944.8	0.8204410
20	2	3	2	680678.0	1316973.4	1239094.6	1.8203829	190613.01	4015806.8	1.9347964
21	2	3	3	1011278.0	1768807.8	1530089.0	1.5130251	262500.67	4840593.0	1.7490817
22	2	3	4	375713.0	586033.3	472219.1	1.2568611	83858.16	1567539.3	1.5597897
23	2	3	5	733105.0	1060668.3	761801.5	1.0391437	186267.29	2539147.1	1.4468163
24	2	3	6	615578.0	891589.6	663850.3	1.0784179	136312.25	2317467.9	1.4483779
25	2	3	7	928584.0	1322345.5	900032.1	0.9692522	218603.02	3198007.1	1.4240452
26	2	3	8	419288.5	673495.8	561654.6	1.3395421	100604.43	2016584.9	1.6062825
27	2	3	9	416626.9	594015.5	486623.4	1.1680078	88631.45	1689406.8	1.4257734
28	2	4	1	8545756.0	3640153.5	5655209.7	0.6617565	187072.33	10746860.5	0.4259604
29	2	4	2	1626135.0	1462800.4	925810.9	0.5693322	221997.73	3598398.7	0.8995565
30	2	4	3	2285581.0	2048822.6	1024568.5	0.4482749	376276.25	4224079.4	0.8964122
31	2	4	4	686659.0	535928.0	383731.9	0.5588391	82599.02	1419797.8	0.7804864
32	2	4	5	1183629.0	921928.0	617450.7	0.5216589	133601.52	2278172.5	0.7788994
33	2	4	6	982014.0	745610.4	533624.4	0.5433980	100379.54	1884772.3	0.7592665
34	2	4	7	1416729.0	1108398.8	715096.4	0.5047517	199015.19	2539418.8	0.7823647
35	2	4	8	837158.0	615993.7	468845.3	0.5600440	89463.41	1617188.0	0.7358154
36	2	4	9	882732.6	650943.0	477774.4	0.5412448	81043.39	1629212.8	0.7374181
37	2	5	1	17152130.0	7736126.7	10387957.3	0.6056366	302942.66	16687093.7	0.4510301
38	2	5	2	3592000.0	3285668.9	1362621.1	0.3793489	771026.07	6078360.6	0.9147185
39	2	5	3	4465180.0	4095595.6	1442093.0	0.3229641	1097004.67	7082192.4	0.9172297
40	2	5	4	1188960.0	1199374.9	534262.7	0.4493529	287432.06	2385174.2	1.0087596
41	2	5	5	1920851.0	1927542.8	728248.2	0.3791279	558202.76	3442219.3	1.0034838
42	2	5	6	1454071.0	1432395.1	582454.2	0.4005679	363868.92	2723569.3	0.9850930
43	2	5	7	1856569.0	1887481.3	701517.4	0.3778569	627566.21	3381331.7	1.0166502
44	2	5	8	792360.0	837714.8	396131.5	0.4999389	191907.27	1751600.1	1.0572402
45	2	5	9	930555.8	850949.9	384700.6	0.4134095	204578.17	1634311.9	0.9144534
46	3	6	1	9399611.0	5755037.6	6567834.9	0.6987348	180441.60	18265593.3	0.6122634
47	3	6	2	2008033.0	1939789.1	1006183.8	0.5010793	317413.06	4429825.2	0.9660146
48	3	6	3	2755678.0	2723326.4	1113493.5	0.4040724	905901.59	5334838.2	0.9882600
49	3	6	4	726580.0	779487.6	522722.3	0.7194285	117784.65	2008142.6	1.0728173
50	3	6	5	1159637.0	1185096.7	620413.3	0.5350065	206609.87	2724836.2	1.0219549
51	3	6	6	816555.0	873829.1	514075.5	0.6295663	160834.01	2294386.4	1.0701411
52	3	6	7	1229585.0	1212081.3	571039.1	0.4644161	275819.73	2425818.8	0.9857646
53	3	6	8	560148.0	550334.7	336086.8	0.5999964	111347.66	1377506.1	0.9824809
54	3	6	9	576602.8	431710.2	312258.2	0.5415481	54365.12	1092275.9	0.7487134
55	3	7	1	5882663.0	3776980.5	6851779.4	1.1647411	253983.75	13868214.4	0.6420528
56	3	7	2	1126338.0	863726.6	505247.8	0.4485756	126592.39	1800768.1	0.7668449
57	3	7	3	1453034.0	1153215.3	548732.1	0.3776457	270168.06	2063801.2	0.7936602
58	3	7	4	419144.0	371370.2	261265.4	0.6233308	48886.67	961551.0	0.8860206
59	3	7	5	709752.0	585998.9	330379.5	0.4654858	87468.17	1290728.1	0.8256390
60	3	7	6	458265.0	400552.1	252606.6	0.5512238	51150.49	954685.2	0.8740621
61	3	7	7	547681.4	512397.3	303167.5	0.5535472	66844.18	1214608.4	0.9355755
62	3	7	8	334529.7	336991.2	241733.4	0.7226068	41551.06	928740.2	1.0073581
63	3	7	9	501208.9	409582.5	330164.9	0.6587371	55259.24	1073558.0	0.8171893
64	3	8	1	3466915.0	5568890.0	16682809.6	4.8120042	284660.51	38845749.2	1.6062955
65	3	8	2	631414.0	618277.7	228390.0	0.3617120	257896.94	1153585.4	0.9791955
66	3	8	3	835650.0	793950.5	182060.6	0.2178670	489246.25	1174701.6	0.9500993
67	3	8	4	250608.0	268291.3	154498.0	0.6164925	51770.97	688230.5	1.0705616
68	3	8	5	399780.0	439683.8	184903.0	0.4625118	156215.33	872511.3	1.0998143
69	3	8	6	341815.0	367532.1	177086.6	0.5180772	124708.10	831415.2	1.0752370
70	3	8	7	597344.9	628839.3	243164.1	0.4070749	300700.95	1149174.2	1.0527241
71	3	8	8	396272.7	467529.6	417911.4	1.0546056	129191.94	1177715.1	1.1798178
72	3	8	9	865307.8	1129546.2	1476335.4	1.7061391	290424.35	3064244.1	1.3053693

biomass

	stock	stratum	length_bin	true_bio	exp_bio	RMSE_bio	CV_bio	LR2.5	UP97.5	bias
2	1	1	2	704.7022	659.1174	301.81521	0.4282876	69.5	1319.9	0.9353134
3	1	1	3	1342.9958	1221.2886	413.99778	0.3082644	288.3	1973.5	0.9093763
4	1	1	4	509.3562	482.8782	262.68173	0.5157132	51.7	1077.0	0.9480167
5	1	1	5	977.2646	887.0938	507.75341	0.5195659	81.2	1783.0	0.9077314

6	1	1	6	831.0901	841.7457	450.04722	0.5415143	109.6	1946.5	1.0128212
7	1	1	7	1961.7952	1715.3937	913.96461	0.4658818	140.9	3510.8	0.8744000
8	1	1	8	1473.8963	1206.4230	729.95874	0.4952579	105.1	2573.4	0.8185264
9	1	1	9	3090.5890	2091.4292	1425.04452	0.4610916	203.4	4034.5	0.6767089
11	1	2	2	546.1504	896.2770	538.31374	0.9856511	264.0	1837.8	1.6410809
12	1	2	3	949.1864	1586.1031	890.95975	0.9386563	521.8	3057.5	1.6710133
13	1	2	4	314.7064	603.8875	430.50124	1.3679456	123.2	1303.5	1.9188917
14	1	2	5	578.4150	1202.1958	885.87256	1.5315518	291.2	2505.9	2.0784312
15	1	2	6	536.2641	1144.1457	851.60576	1.5880342	254.9	2520.9	2.1335489
16	1	2	7	877.9498	2106.4781	1720.69306	1.9598992	449.7	4747.3	2.3993150
17	1	2	8	490.2926	1315.6723	1158.10104	2.3620609	247.2	3157.9	2.6834429
18	1	2	9	1223.0119	2036.1380	1420.05874	1.1611161	418.4	4686.7	1.6648555
20	2	3	2	257.9074	500.1653	470.91139	1.8258936	72.4	1526.6	1.9393215
21	2	3	3	500.8869	867.3767	747.82381	1.4929993	128.6	2375.4	1.7316816
22	2	3	4	224.1155	349.5735	281.68181	1.2568602	50.0	935.0	1.5597919
23	2	3	5	500.9594	723.2071	518.98150	1.0359751	127.1	1731.1	1.4436441
24	2	3	6	498.4988	721.8592	537.41654	1.0780698	110.4	1876.3	1.4480660
25	2	3	7	973.0501	1386.2042	943.66523	0.9698013	229.0	3354.6	1.4245969
26	2	3	8	628.6183	1018.8189	852.17416	1.3556304	152.2	3045.3	1.6207273
27	2	3	9	1330.7216	1584.3188	1235.51639	0.9284560	237.4	4475.0	1.1905712
29	2	4	2	617.2185	555.5480	351.54948	0.5695706	84.3	1366.2	0.9000833
30	2	4	3	1123.7044	1004.7236	503.13367	0.4477456	184.3	2069.5	0.8941173
31	2	4	4	409.5970	319.6855	228.89889	0.5588393	49.3	846.9	0.7804880
32	2	4	5	807.8594	628.6119	421.33993	0.5215511	91.1	1553.5	0.7781204
33	2	4	6	795.8706	603.6824	432.38801	0.5432893	81.3	1526.0	0.7585183
34	2	4	7	1485.0560	1161.8066	749.50782	0.5047001	208.6	2663.6	0.7823319
35	2	4	8	1270.8213	931.8815	711.39609	0.5597924	135.3	2447.8	0.7332907
36	2	4	9	2520.8990	1735.4266	1361.84865	0.5402234	216.3	4341.3	0.6884158
38	2	5	2	1361.1085	1247.8333	516.83567	0.3797167	293.2	2309.3	0.9167773
39	2	5	3	2188.2372	2008.4185	706.81123	0.3230049	538.8	3474.5	0.9178249
40	2	5	4	709.2231	715.4351	318.69193	0.4493536	171.5	1422.8	1.0087589
41	2	5	5	1311.2956	1314.2751	496.54876	0.3786703	380.5	2347.0	1.0022721
42	2	5	6	1176.7196	1159.7636	471.57294	0.4007522	294.6	2205.4	0.9855904
43	2	5	7	1937.3720	1978.6408	735.75934	0.3797718	657.5	3544.0	1.0213014
44	2	5	8	1187.4878	1267.2999	600.75888	0.5059074	289.7	2653.2	1.0672109
45	2	5	9	3263.9906	2269.2672	1412.87107	0.4328662	557.3	4364.5	0.6952432
47	3	6	2	761.2854	735.7945	381.62162	0.5012859	120.4	1679.9	0.9665159
48	3	6	3	1352.8026	1333.4888	545.34002	0.4031187	443.5	2612.8	0.9857231
49	3	6	4	433.4101	464.9708	311.80636	0.7194256	70.3	1197.9	1.0728194
50	3	6	5	790.4542	807.7320	422.83826	0.5349308	140.7	1858.3	1.0218581
51	3	6	6	660.4672	707.5368	416.33050	0.6303576	130.2	1856.1	1.0712672
52	3	6	7	1291.9545	1271.9414	599.23524	0.4638207	288.3	2552.4	0.9845094
53	3	6	8	838.3143	829.5930	506.34128	0.6039993	167.7	2075.8	0.9895966
54	3	6	9	2050.4870	1169.0602	1156.63236	0.5640769	149.6	2964.2	0.5701378
56	3	7	2	426.2993	327.6214	191.16894	0.4484383	48.0	682.8	0.7685244
57	3	7	3	713.8823	564.6948	270.00691	0.3782233	132.2	1010.9	0.7910195
58	3	7	4	250.0224	221.5245	155.84607	0.6233285	29.2	573.6	0.8860187
59	3	7	5	483.7935	399.4158	225.19032	0.4654679	59.6	879.4	0.8255915
60	3	7	6	369.9720	324.3203	204.28600	0.5521662	41.4	772.8	0.8766078
61	3	7	7	575.7413	537.6797	318.17569	0.5526366	70.2	1274.6	0.9338912
62	3	7	8	512.7729	507.9459	364.36185	0.7105716	62.6	1397.0	0.9905865
63	3	7	9	1661.4012	1108.5727	1021.69160	0.6149578	150.8	2881.4	0.6672517
65	3	8	2	239.2613	234.5139	86.60268	0.3619587	97.8	437.7	0.9801583
66	3	8	3	411.2117	388.7533	89.63612	0.2179805	239.6	575.5	0.9453848
67	3	8	4	149.4895	160.0381	92.15896	0.6164914	30.9	410.5	1.0705645
68	3	8	5	273.0141	299.6790	125.91690	0.4612102	106.5	594.6	1.0976685
69	3	8	6	277.1222	297.5824	143.32218	0.5171804	101.0	672.7	1.0738309
70	3	8	7	628.7998	659.9178	254.92390	0.4054134	316.0	1208.8	1.0494879
71	3	8	8	606.2867	704.6753	628.45253	1.0365601	195.2	1782.2	1.1622807
72	3	8	9	2830.4974	3058.1987	3947.48808	1.3946270	777.5	8401.7	1.0804457

BY STOCK & LENGTH

Total fits by length bin

	numbers						
	stock	length_bin	true_pop	exp_pop	RMSE	CV	bias
1	1	1	16967870	10526712	8420615.7	0.4962683	0.6203909
4	1	2	3301269	4098903	1624654.6	0.4921303	1.2416143
7	1	3	4652575	5730830	2006539.1	0.4312750	1.2317545
10	1	4	1381480	1821883	845446.6	0.6119862	1.3187904
13	1	5	2280736	3064076	1497582.0	0.6566222	1.3434594
16	1	6	1690434	2451725	1188775.6	0.7032369	1.4503523
19	1	7	2695764	3622369	1835952.6	0.6810509	1.3437263
22	1	8	1294287	1670197	907045.3	0.7008069	1.2904379
25	1	9	1435985	1565394	737065.3	0.5132822	1.0901190

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2      2          1 29809355 14749498 12265961.2 0.4114803 0.4947943
5      2          2  5898813  6065443  2061363.0 0.3494539 1.0282480
8      2          3  7762039  7913226  2338919.6 0.3013280 1.0194777
11     2          4  2251332  2321336   809739.2 0.3596712 1.0310945
14     2          5  3837585  3910139  1221446.8 0.3182853 1.0189062
17     2          6  3051663  3069595  1031845.5 0.3381256 1.0058762
20     2          7  4201882  4318226  1346680.1 0.3204945 1.0276885
23     2          8  2048807  2127204   831980.8 0.4060807 1.0382651
26     2          9  2229915  2095908   782984.9 0.3511276 0.9399050
3      3          1 18749189 15100908 19193735.2 1.0237102 0.8054166
6      3          2  3765785  3421793  1148844.3 0.3050743 0.9086534
9      3          3  5044362  4670492  1254639.7 0.2487212 0.9258836
12     3          4  1396332  1419149   604456.7 0.4328889 1.0163407
15     3          5  2269169  2210779   726809.7 0.3202977 0.9742683
18     3          6  1616635  1641913   599536.0 0.3708542 1.0156364
21     3          7  2374611  2353318   690742.3 0.2908865 0.9910329
24     3          8  1290950  1354855   588251.0 0.4556728 1.0495024
27     3          9  1943119  1970839  1544694.2 0.7949559 1.0142655


   biomass
   stock length_bin  true_bio   exp_bio      RMSE        CV      bias
1      1          2 1250.8526 1555.3944  617.1500 0.4933835 1.2434674
4      1          3 2292.1822 2807.3917  982.4477 0.4286080 1.2247681
7      1          4  824.0626 1086.7657  504.3144 0.6119855 1.3187902
10     1          5 1555.6796 2089.2896 1021.0699 0.6563497 1.3430076
13     1          6 1367.3543 1985.8914  963.2107 0.7044339 1.4523606
16     1          7 2839.7450 3821.8718 1948.3624 0.6861047 1.3458503
19     1          8 1964.1889 2522.0953 1368.9550 0.6969569 1.2840391
22     1          9 4313.6008 4127.5672 2011.7949 0.4663841 0.9568728
2      2          2 2236.2343 2303.5466  782.6006 0.3499636 1.0301007
5      2          3 3812.8285 3880.5188 1145.4109 0.3004097 1.0177533
8      2          4 1342.9355 1384.6941  483.0154 0.3596713 1.0310950
11     2          5 2620.1145 2666.0941  832.7243 0.3178198 1.0175487
14     2          6 2471.0890 2485.3052  835.5579 0.3381335 1.0057530
17     2          7 4395.4781 4526.6516 1411.9518 0.3212283 1.0298428
20     2          8 3086.9274 3218.0003 1262.2189 0.4088917 1.0424606
23     2          9 7115.6112 5589.0126 2318.9086 0.3258903 0.7854578
3      3          2 1426.8460 1297.9298  435.5234 0.3052351 0.9096495
6      3          3 2477.8967 2286.9369  615.0887 0.2482302 0.9229347
9      3          4  832.9220  846.5334  360.5613 0.4328873 1.0163418
12     3          5 1547.2618 1506.8268  495.3362 0.3201373 0.9738667
15     3          6 1307.5613 1329.4395  485.3917 0.3712191 1.0167320
18     3          7 2496.4956 2469.5389  724.7792 0.2903186 0.9892022
21     3          8 1957.3738 2042.2142  885.4906 0.4523871 1.0433440
24     3          9 6542.3856 5335.8316 4238.4330 0.6478421 0.8155789
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STRATUM FITS +25cm
   numbers
  stratum true_pop  exp_pop    RMSE        CV      bias
1       1 11752296 10597841 1892079 0.1609965 0.9017677
2       2  6980234 13427536 3491873 0.5002516 1.9236512
3       3  5180851  8213929 2546149 0.4914537 1.5854400
4       4  9900638  8090425 1918219 0.1937470 0.8171620
5       5 16200547 15516723 2426612 0.1497858 0.9577901
6       6  9832819  9695655 1926459 0.1959213 0.9860504
7       7  5549953  4633834 1028084 0.1852419 0.8349321
8       8  4318192  4713651 1608748 0.3725514 1.0915796

   biomass
  stratum  true_bio   exp_bio     RMSE        CV      bias
1       1 10891.689  9105.370 2047.136 0.1879540 0.8359924
2       2  5515.977 10890.897 3016.202 0.5468120 1.9744278
3       3  4914.758  7151.524 2135.815 0.4345718 1.4551121
4       4  9031.026  6941.366 1927.716 0.2134548 0.7686132
5       5 13135.434 11960.933 2058.073 0.1566810 0.9105853
6       6  8179.175  7320.117 1686.903 0.2062436 0.8949701
7       7  4993.885  3991.775 1226.389 0.2455781 0.7993326
8       8  5415.683  5803.359 4012.857 0.7409698 1.0715839
```

STOCK FITS +25cm

numbers

	stock	true_pop	exp_pop	RMSE	CV	bias
1	1	18732530	24025377	3971541	0.2120131	1.2825484
2	2	31282036	31821077	4006355	0.1280721	1.0172317
3	3	19700964	19043140	2712245	0.1376707	0.9666095

biomass

	stock	true_bio	exp_bio	RMSE	CV	bias
1	1	16407.67	19996.27	3645.304	0.2221708	1.2187149
2	2	27081.22	26053.82	3537.437	0.1306233	0.9620624
3	3	18588.74	17115.25	4522.466	0.2432906	0.9207320

SNA 1 FITS (25 cm +)

numbers

	true_pop	exp_pop	RMSE	CV	bias
1	69715530	74889594	6259416	0.08978511	1.074217

biomass

	true_bio	exp_bio	RMSE	CV	bias
1	62077.63	63165.34	6801.059	0.1095573	1.017522

TAG RECOVERY FITS

	release	recovery	TagObs	TagExp	RMSE	CV
1	1	1	157.904	160.27275514	4.5861486	0.02904390
2	1	2	85.456	78.44685404	9.4524748	0.11061218
3	1	3	29.920	29.25820561	3.8216973	0.12773052
4	1	4	3.230	3.69366400	1.5144142	0.46885890
5	1	5	0.463	0.62021567	0.6292554	1.35908293
6	1	6	0.092	0.23380092	0.4338163	4.71539490
7	1	7	0.023	0.06766266	0.2284916	9.93441629
8	1	8	0.003	0.05092734	0.2573421	85.78071133
9	2	1	56.960	61.57400099	7.5352274	0.13228981
10	2	2	96.234	90.13518464	8.4943993	0.08826817
11	2	3	58.072	53.38029838	7.5020836	0.12918590
12	2	4	9.479	10.93533835	3.0002594	0.31651645
13	2	5	2.030	2.53994094	1.3652962	0.67255971
14	2	6	0.394	0.65163586	0.6445096	1.63581118
15	2	7	0.125	0.83502753	0.8630286	6.90422864
16	2	8	0.032	0.21641846	0.3195037	9.98449142
17	3	1	12.507	16.62190013	5.2387128	0.41886246
18	3	2	36.248	38.16694036	5.6133079	0.15485842
19	3	3	66.634	70.12259675	5.8321476	0.08752510
20	3	4	31.167	40.26933724	10.4573609	0.33552671
21	3	5	8.991	13.08807822	5.0010436	0.55622774
22	3	6	2.231	3.25763098	1.7671323	0.79208083
23	3	7	0.582	0.94865492	0.7781823	1.33708293
24	3	8	0.150	0.54662164	0.5694144	3.79609578
25	4	1	2.716	2.69574184	1.3185712	0.48548276
26	4	2	11.660	9.89460690	3.2309554	0.27709737
27	4	3	61.438	51.98235060	10.9668929	0.17850342
28	4	4	111.780	110.58250846	4.6996933	0.04204413
29	4	5	47.126	46.90540488	5.8895455	0.12497444
30	4	6	12.205	12.73720550	2.9701464	0.24335489
31	4	7	3.490	3.75549375	1.4559600	0.41718051
32	4	8	0.830	1.96753160	1.4885822	1.79347248
33	5	1	0.695	0.82445454	0.7386125	1.06275183
34	5	2	4.643	4.14513585	1.5575315	0.33545800
35	5	3	32.547	30.55936552	4.1179698	0.12652379
36	5	4	86.173	85.26680738	6.6743763	0.07745322
37	5	5	161.240	160.31410429	5.2650879	0.03265373
38	5	6	54.219	55.35062091	5.5962712	0.10321605
39	5	7	16.529	17.48609396	3.0440864	0.18416640
40	5	8	3.715	4.24520588	1.5895134	0.42786364
41	6	1	0.135	0.23680007	0.4392012	3.25334242
42	6	2	0.772	0.84669929	0.6979156	0.90403577

43	6	3	6.626	6.01872716	1.8539705	0.27980238
44	6	4	18.538	18.31245525	3.0802126	0.16615668
45	6	5	45.652	44.52965808	5.3943308	0.11816198
46	6	6	85.285	83.18954933	4.8494610	0.05686183
47	6	7	38.334	38.77348956	4.5778059	0.11941895
48	6	8	9.715	9.64043437	2.0059296	0.20647758
49	7	1	0.023	0.03989882	0.1585344	6.89280208
50	7	2	0.137	0.66463218	0.6953701	5.07569400
51	7	3	1.092	1.05315649	0.7772474	0.71176500
52	7	4	3.268	3.26496567	1.4296589	0.43747213
53	7	5	8.472	8.49954990	2.4837774	0.29317486
54	7	6	23.355	23.55212080	4.2164902	0.18053908
55	7	7	95.832	96.73619663	2.8869964	0.03012560
56	7	8	40.038	40.00448159	4.3896418	0.10963689
57	8	1	0.001	0.01950885	0.1043186	104.31863366
58	8	2	0.020	0.11484787	0.1879574	9.39786965
59	8	3	0.161	0.40498633	0.4732025	2.93914622
60	8	4	0.520	1.15306265	0.9781001	1.88096182
61	8	5	1.287	1.36778133	1.0276549	0.79848864
62	8	6	3.949	3.96715807	1.7213092	0.43588484
63	8	7	26.810	27.06127303	4.1468153	0.15467420
64	8	8	127.025	122.77646868	5.0579630	0.03981864

	rec_stra	Length_bin	TagObs	TagExp	RMSE	CV
1	1	1	11.052	11.792864	2.132039	0.19290982
2	1	2	36.266	38.240154	4.012609	0.11064381
3	1	3	60.599	63.750577	5.330582	0.08796485
4	1	4	14.763	15.527037	2.273944	0.15402992
5	1	5	25.440	26.600134	3.047040	0.11977359
6	1	6	16.486	17.217717	2.372068	0.14388381
7	1	7	25.696	26.777752	3.210599	0.12494550
8	1	8	16.245	16.998686	2.449554	0.15078819
9	1	9	24.394	25.380139	3.004147	0.12315104
10	2	1	11.979	11.469371	2.516074	0.21004042
11	2	2	35.590	33.820868	4.465871	0.12548106
12	2	3	60.807	57.840860	6.144692	0.10105239
13	2	4	15.389	14.576043	2.849940	0.18519334
14	2	5	25.928	24.524043	3.922112	0.15126936
15	2	6	17.070	15.835156	3.119044	0.18272081
16	2	7	27.262	25.510525	4.178421	0.15326904
17	2	8	16.804	15.860992	2.993642	0.17815054
18	2	9	24.341	22.977044	3.696140	0.15184831
19	3	1	13.929	13.057231	2.971928	0.21336261
20	3	2	35.905	33.641411	5.247519	0.14615010
21	3	3	67.292	63.295474	7.465500	0.11094186
22	3	4	19.564	18.301725	3.296558	0.16850123
23	3	5	31.900	29.953867	4.526970	0.14191128
24	3	6	21.075	20.282058	3.189881	0.15135853
25	3	7	30.407	29.178463	4.033282	0.13264322
26	3	8	16.768	15.997504	3.040070	0.18130190
27	3	9	19.650	19.071954	3.276843	0.16676045
28	4	1	15.715	15.829000	2.723158	0.17328400
29	4	2	34.118	35.063610	4.130326	0.12106003
30	4	3	66.631	68.155537	5.870333	0.08810213
31	4	4	20.312	20.972237	3.250236	0.16001557
32	4	5	33.691	35.081891	4.259482	0.12642788
33	4	6	23.756	24.770005	3.487187	0.14679183
34	4	7	34.578	36.188576	4.351575	0.12584807
35	4	8	17.343	18.226129	3.003133	0.17316112
36	4	9	18.011	19.191154	3.366757	0.18692782
37	5	1	14.028	14.182245	2.471733	0.17619998
38	5	2	32.798	32.967650	4.088505	0.12465713
39	5	3	64.142	65.795247	5.969445	0.09306609
40	5	4	19.892	20.150137	3.082566	0.15496510
41	5	5	34.749	35.102558	3.804172	0.10947572
42	5	6	25.769	25.750047	3.310724	0.12847701
43	5	7	39.368	39.686368	4.059558	0.10311821
44	5	8	21.492	21.363452	3.002320	0.13969478
45	5	9	23.023	22.867030	3.094127	0.13439288
46	6	1	8.660	9.021887	2.139582	0.24706489
47	6	2	24.738	25.151657	3.685939	0.14899908
48	6	3	46.055	46.043033	4.881110	0.10598437
49	6	4	12.063	12.285097	2.517363	0.20868464
50	6	5	21.249	21.537158	3.273906	0.15407340
51	6	6	15.107	15.209152	2.753781	0.18228508
52	6	7	24.505	24.444240	3.356058	0.13695403

53	6	8	12.963	13.139998	2.508708	0.19352834
54	6	9	16.390	16.107501	2.668924	0.16283854
55	7	1	6.539	6.743347	1.709927	0.26149668
56	7	2	27.312	28.413063	3.652598	0.13373601
57	7	3	51.033	52.694401	4.886317	0.09574818
58	7	4	11.985	12.394489	2.327534	0.19420392
59	7	5	21.699	22.065370	3.137112	0.14457402
60	7	6	15.271	15.573025	2.579078	0.16888728
61	7	7	25.036	25.145368	3.223629	0.12875973
62	7	8	11.702	11.615590	2.171308	0.18555013
63	7	9	11.148	11.019239	2.090187	0.18749432
64	8	1	6.425	6.209867	1.387016	0.21587801
65	8	2	31.188	30.604703	2.547387	0.08167843
66	8	3	58.249	57.240809	3.313686	0.05688828
67	8	4	13.120	12.866536	1.640912	0.12506950
68	8	5	22.292	22.075076	2.240076	0.10048790
69	8	6	14.711	14.599859	1.759224	0.11958560
70	8	7	20.719	20.631260	2.049160	0.09890244
71	8	8	8.763	8.857398	1.508581	0.17215344
72	8	9	6.041	6.362582	1.558052	0.25791301

	TagObs	TagExp	RMSE	CV
1	1806.98	1806.874	29.68506	0.016428

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PROPORTIONAL MOVEMENT FITS
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	Lb__Fr__To	true_mm	geo_obs	RMSE	CV	LR2.5	UP97.5
1	1 - 1 - 1	0.858749000	0.814425776	0.180687520	0.21040784	7.547980e-02	0.963455500
2	1 - 1 - 2	0.139050975	0.160771265	0.133736667	0.96178158	2.849321e-02	0.519039215
3	1 - 1 - 3	0.002199921	0.024802955	0.127722202	58.05762314	8.106563e-05	0.174228693
4	1 - 2 - 1	0.150323860	0.170186152	0.092446924	0.61498503	2.556982e-02	0.337370458
5	1 - 2 - 2	0.738555933	0.674559709	0.185767572	0.25152810	1.170463e-01	0.883120400
6	1 - 2 - 3	0.111120437	0.155254138	0.144426361	1.29972816	2.329883e-02	0.571573686
7	1 - 3 - 1	0.001321854	0.008355997	0.049139968	37.17503170	2.432614e-04	0.017375214
8	1 - 3 - 2	0.177218823	0.166728132	0.085596156	0.48299698	1.906751e-02	0.343465187
9	1 - 3 - 3	0.821458933	0.824915858	0.095537741	0.11630252	6.468080e-01	0.973052333
10	2 - 1 - 1	0.863663500	0.838192034	0.101694191	0.11774747	5.860715e-01	0.951751000
11	2 - 1 - 2	0.134116670	0.158144721	0.100919347	0.75247430	4.410436e-02	0.405040325
12	2 - 1 - 3	0.002220054	0.003663242	0.002830165	1.27481807	2.089518e-04	0.009676908
13	2 - 2 - 1	0.171122367	0.172934994	0.052969324	0.30954062	7.194224e-02	0.276139015
14	2 - 2 - 2	0.711572533	0.711096153	0.075953405	0.10674022	5.416054e-01	0.838806033
15	2 - 2 - 3	0.117304604	0.115968846	0.052742970	0.44962404	3.715755e-02	0.263379903
16	2 - 3 - 1	0.001286535	0.004365367	0.004100399	3.18716536	4.617857e-04	0.010260100
17	2 - 3 - 2	0.180456522	0.184918585	0.056403304	0.31255897	9.213991e-02	0.313451436
18	2 - 3 - 3	0.818257233	0.810716053	0.057074689	0.06975152	6.823915e-01	0.902980533
19	3 - 1 - 1	0.864165500	0.846763357	0.085169061	0.09855642	6.591440e-01	0.950036000
20	3 - 1 - 2	0.133691885	0.149771929	0.084655719	0.63321509	4.739254e-02	0.334176140
21	3 - 1 - 3	0.002142748	0.003464723	0.002376914	1.10928323	4.543958e-04	0.008041624
22	3 - 2 - 1	0.158601927	0.169493609	0.048634369	0.30664425	7.979954e-02	0.259237350
23	3 - 2 - 2	0.727094067	0.714383301	0.066956449	0.09208774	5.681455e-01	0.821761667
24	3 - 2 - 3	0.114303678	0.116123091	0.044018240	0.38509907	5.677281e-02	0.233409760
25	3 - 3 - 1	0.001250112	0.004186948	0.003601882	2.88124780	6.816633e-04	0.008812946
26	3 - 3 - 2	0.170413280	0.172477279	0.041288772	0.24228612	9.451642e-02	0.259152087
27	3 - 3 - 3	0.828336333	0.823335773	0.041736422	0.05038584	7.330548e-01	0.899610700
28	4 - 1 - 1	0.856559500	0.850735157	0.083691350	0.09770641	6.641990e-01	0.954539500
29	4 - 1 - 2	0.141295110	0.145301395	0.082816150	0.58612184	4.120112e-02	0.329220810
30	4 - 1 - 3	0.002145239	0.003963463	0.004141361	1.93048977	1.883987e-04	0.012606718
31	4 - 2 - 1	0.131129173	0.159226711	0.065393858	0.49869801	6.117711e-02	0.284887000
32	4 - 2 - 2	0.761521600	0.722505158	0.100633448	0.13214786	5.076663e-01	0.859964667
33	4 - 2 - 3	0.107349127	0.118268130	0.069576514	0.64813302	3.236427e-02	0.309252290
34	4 - 3 - 1	0.001289106	0.004637771	0.004634730	3.59530503	3.761388e-04	0.012118608
35	4 - 3 - 2	0.166752871	0.177142327	0.063483137	0.38070191	7.172977e-02	0.323235077
36	4 - 3 - 3	0.831958100	0.818219909	0.064390391	0.07739619	6.674930e-01	0.922142293
37	5 - 1 - 1	0.846992500	0.849381805	0.068769114	0.08119212	6.952180e-01	0.944590000
38	5 - 1 - 2	0.150806710	0.146975928	0.068261034	0.45263924	5.176795e-02	0.299184479
39	5 - 1 - 3	0.002200553	0.003642284	0.003018055	1.37149861	3.183331e-04	0.010352999
40	5 - 2 - 1	0.118294067	0.154671783	0.072714078	0.61468913	6.392265e-02	0.279790050
41	5 - 2 - 2	0.777935800	0.736453227	0.091624591	0.11777912	5.624719e-01	0.856210100
42	5 - 2 - 3	0.103770180	0.108874981	0.052300713	0.50400523	3.539184e-02	0.251153362
43	5 - 3 - 1	0.001322451	0.006466085	0.034503410	26.09049923	6.142987e-04	0.010855290
44	5 - 3 - 2	0.165961482	0.173537296	0.054347925	0.32747313	8.952695e-02	0.298534277

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45  5 - 3 - 3 0.832716167 0.819996616 0.063039037  0.07570291 6.934222e-01 0.905145333
46  6 - 1 - 1 0.837647500 0.847378767 0.074467870  0.08890120 6.666560e-01 0.948906000
47  6 - 1 - 2 0.160107570 0.149345369 0.074135068  0.46303288 4.843185e-02 0.327240825
48  6 - 1 - 3 0.002245003 0.003275863 0.002755557  1.22741837 1.882670e-04 0.009456217
49  6 - 2 - 1 0.114179020 0.155578419 0.076002615  0.66564431 5.299615e-02 0.304627301
50  6 - 2 - 2 0.786978667 0.737620767 0.097420049  0.12378995 5.350988e-01 0.868580100
51  6 - 2 - 3 0.098842144 0.106800813 0.053175057  0.53797960 3.436664e-02 0.255084327
52  6 - 3 - 1 0.001487237 0.004745502 0.004737590  3.18549813 3.388505e-04 0.012669035
53  6 - 3 - 2 0.175610207 0.179916272 0.060167838  0.34262153 8.069432e-02 0.318459048
54  6 - 3 - 3 0.822902233 0.815338219 0.060931316  0.07404442 6.751237e-01 0.915550767
55  7 - 1 - 1 0.844123500 0.849865485 0.065345578  0.07741234 6.982730e-01 0.945097500
56  7 - 1 - 2 0.153662120 0.146981348 0.065097637  0.42364141 5.102980e-02 0.299552375
57  7 - 1 - 3 0.002214117 0.003153170 0.002599838  1.17420970 1.954798e-04 0.009917952
58  7 - 2 - 1 0.102319653 0.146251602 0.076717127  0.74977900 5.514760e-02 0.277146390
59  7 - 2 - 2 0.798281833 0.751229878 0.089138197  0.11166256 5.830577e-01 0.860286967
60  7 - 2 - 3 0.099398652 0.102518518 0.042632880  0.42890803 4.125575e-02 0.204348296
61  7 - 3 - 1 0.001373821 0.005307467 0.029604202 21.54879934 4.512823e-04 0.011409300
62  7 - 3 - 2 0.163432494 0.170953607 0.051048553  0.31235253 9.404542e-02 0.293210413
63  7 - 3 - 3 0.835193300 0.823738917 0.057516409  0.06886598 6.961696e-01 0.901048837
64  8 - 1 - 1 0.852767500 0.848351134 0.075445065  0.08847085 6.546350e-01 0.952453500
65  8 - 1 - 2 0.144710545 0.147409056 0.074862040  0.51732263 4.373079e-02 0.339776900
66  8 - 1 - 3 0.002522037 0.004239797 0.004263732  1.69059043 1.630900e-04 0.014271896
67  8 - 2 - 1 0.083600687 0.129828139 0.077453359  0.92646797 4.186582e-02 0.264600145
68  8 - 2 - 2 0.822792333 0.769380416 0.102969815  0.12514678 5.713640e-01 0.891239800
69  8 - 2 - 3 0.093606782 0.100791442 0.053849128  0.57526951 3.149939e-02 0.229656073
70  8 - 3 - 1 0.001254936 0.004673541 0.005023045  4.00262962 3.047948e-04 0.013213161
71  8 - 3 - 2 0.142892487 0.154467703 0.056878558  0.39805142 6.334307e-02 0.282638314
72  8 - 3 - 3 0.855852667 0.840858769 0.058051749  0.06782914 7.051083e-01 0.932240933
73  9 - 1 - 1 0.861227500 0.851679668 0.077239799  0.08968571 6.727400e-01 0.949528000
74  9 - 1 - 2 0.136421415 0.143421450 0.073542748  0.53908507 4.604523e-02 0.309548010
75  9 - 1 - 3 0.002351138 0.004898881 0.020189275  8.58702265 2.534411e-04 0.013373473
76  9 - 2 - 1 0.094165580 0.125254931 0.059696031  0.63394747 4.965016e-02 0.244553380
77  9 - 2 - 2 0.812675567 0.783789101 0.082045790  0.10095762 6.051105e-01 0.894449233
78  9 - 2 - 3 0.093159383 0.090955962 0.053647488  0.57586778 2.294041e-02 0.207668315
79  9 - 3 - 1 0.001271442 0.004338058 0.004367899  3.43538949 3.705098e-04 0.012580075
80  9 - 3 - 2 0.143526060 0.158310703 0.055021625  0.38335634 7.073047e-02 0.280199456
81  9 - 3 - 3 0.855202467 0.837351244 0.056318452  0.06585394 7.128058e-01 0.925239900


Overall CV on movement
0.02417293


=====================================================================
GROWTH PARAMETER FITS
=====================================================================
  parameter observed  expected       RMSE         CV    LR2.5   UP97.5
1  mu_Alpha     5.47 5.4060261 0.07843242 0.01433865 5.322050 5.493360
2   mu_Beta     2.89 2.8630057 2.60746985 0.90223870 2.788190 2.958120
3     theta     1.00 0.9917863 4.47824129 4.47824129 0.942708 1.000000
4     omega     0.80 0.8017239 4.66827795 5.83534744 0.794106 0.809833
```

i. Design scenario: 90% examination of commercial catch; 60000 tags released

```
Mean number of tags released
  stratum      Tags      Cost
1       1  9659.833 149696.75
2       2  6493.969 100134.41
3       3  4251.111  57692.83
4       4  8327.086 112288.51
5       5 15105.660 202966.23
6       6  8700.154 134801.96
7       7  5289.745  81835.99
8       8  3585.705  56085.36
      tot     Tags   Cost
1 Total   61413.26 895502

Mean number of fish examined
  stratum Fishexam     Cost
1       1 659273.3 606043.5
2       2 660197.5 606037.0
3       3 677192.5 248818.0
4       4 677170.9 248522.0
5       5 677247.1 248424.0
```

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6       6 484552.4 248787.5
7       7 484515.2 248779.0
8       8 484819.3 248712.0
       tot    exam    Cost
1 Total    4804968 2704123

Mean number of tags recovered
  stratum    Tags
1       1 334.894
2       2 342.089
3       3 375.103
4       4 382.280
5       5 398.032
6       6 260.724
7       7 261.429
8       8 262.364
       tot     tags
1 Total    2616.915

=====================================================================
POPULATION FITS
=====================================================================

BY STRATUM & LENGTH

Total fits by length bin

   Numbers

   stock stratum length_bin   true_pop   exp_pop       RMSE        CV      LR2.5     UP97.5      bias
1      1       1          1  9819394.0 4685968.4  7251665.7 0.7385044  101662.62 10927933.2 0.4772156
2      1       1          2  1858781.0 1753077.2   647674.8 0.3484406  435695.97  3062144.5 0.9431327
3      1       1          3  2720390.0 2496331.5   722859.5 0.2657191 1166694.99  3922725.5 0.9176374
4      1       1          4   853898.0  805977.2   386069.1 0.4521255  103690.35  1716046.0 0.9438800
5      1       1          5  1432697.0 1291720.6   548953.4 0.3831608  166312.64  2369077.5 0.9016007
6      1       1          6  1027808.0  993793.4   458014.8 0.4456229  156335.93  2018529.9 0.9669057
7      1       1          7  1848468.0 1588845.0   752107.2 0.4068814  192538.50  3053553.2 0.8595469
8      1       1          8   971744.0  789907.8   496616.5 0.5110569   72605.14  1618341.9 0.8128765
9      1       1          9  1038509.6  787945.1   430946.7 0.4149665   91425.24  1478830.7 0.7587269
10     1       2          1  7148476.0 6010674.6  5393360.8 0.7544770  493412.99 13366063.3 0.8408330
11     1       2          2  1442488.0 2348255.7  1286845.6 0.8921014  719240.23  4370312.7 1.6279204
12     1       2          3  1932185.0 3254547.0  1695067.9 0.8772804 1324109.57  5461459.6 1.6843868
13     1       2          4   527582.0 1022311.8   689566.1 1.3070312  252189.01  2121412.9 1.9377307
14     1       2          5   848039.0 1743507.1  1186677.4 1.3993194  448660.99  3533678.5 2.0559279
15     1       2          6   662626.0 1420372.5   993922.2 1.4999747  394627.83  2859841.8 2.1435508
16     1       2          7   847296.2 1966486.1  1476444.0 1.7425359  479180.61  4038320.2 2.3208957
17     1       2          8   322543.0  876837.7   739933.8 2.2940625  192572.01  1938404.7 2.7185140
18     1       2          9   397475.0  780277.8   565597.0 1.4229748  204042.36  1742993.5 1.9630865
19     2       3          1  4111469.0 2895412.2  2681256.2 0.6521407  269166.65  8787326.4 0.7042281
20     2       3          2   680678.0 1186039.4  1023116.2 1.5030839  210932.86  3249959.2 1.7424383
21     2       3          3  1011278.0 1634157.1  1338821.0 1.3238902  323081.77  4415820.2 1.6159326
22     2       3          4   375713.0  552419.1   409183.1 1.0890843   96467.81  1490342.3 1.4703219
23     2       3          5   733105.0  986401.6   650329.1 0.8870886  201854.69  2341465.1 1.3455121
24     2       3          6   615578.0  812948.2   525132.8 0.8530727  159802.61  1925473.1 1.3206259
25     2       3          7   928584.0 1233150.6   762790.5 0.8214556  229317.14  2737020.2 1.3279904
26     2       3          8   419288.5  619129.4   462686.5 1.1035040   96978.72  1604124.4 1.4766191
27     2       3          9   416626.9  551328.5   400547.8 0.9614066  101977.68  1366466.6 1.3233148
28     2       4          1  8545756.0 3581232.6  5570915.2 0.6518926  280870.85  9426791.3 0.4190656
29     2       4          2  1626135.0 1469350.7   758521.1 0.4664564  333035.99  3103338.9 0.9035847
30     2       4          3  2285581.0 2029053.2   924203.3 0.4043625  485083.07  3859333.6 0.8877625
31     2       4          4   686659.0  563473.8   324426.3 0.4724707  135089.35  1209223.7 0.8206021
32     2       4          5  1183629.0  957476.8   538579.9 0.4550243  223377.60  2071355.8 0.8089332
33     2       4          6   982014.0  770286.8   466872.0 0.4754229  158521.33  1711212.3 0.7843950
34     2       4          7  1416729.0 1139097.7   623230.3 0.4399079  269903.23  2321924.7 0.8040336
35     2       4          8   837158.0  629878.2   411815.9 0.4919214  135305.61  1406802.7 0.7524006
36     2       4          9   882732.6  659966.8   414713.3 0.4698063  122377.62  1468712.7 0.7476407
37     2       5          1 17152130.0 7668005.1 10246898.0 0.5974126  278305.30 14959379.3 0.4470585
38     2       5          2  3592000.0 3334974.7  1081262.1 0.3010195 1335892.78  5471613.0 0.9284451
39     2       5          3  4465180.0 4160389.7  1152975.2 0.2582147 1860429.37  6714000.7 0.9317406
40     2       5          4  1188960.0 1158825.6   414827.8 0.3488997  399812.26  2078606.3 0.9746548
41     2       5          5  1920851.0 1896969.9   556857.4 0.2899014  815763.28  3095271.4 0.9875674
42     2       5          6  1454071.0 1422501.2   466074.5 0.3205308  544067.32  2427289.9 0.9782887
43     2       5          7  1856569.0 1880684.0   549415.9 0.2959308  795717.55  3099979.5 1.0129890
44     2       5          8   792360.0  833391.3   318334.7 0.4017551  287575.29  1561802.2 1.0517837
45     2       5          9   930555.8  817892.0   322154.5 0.3461958  291112.96  1447185.8 0.8789285
46     3       6          1  9399611.0 5399630.8  6032713.7 0.6418046  134203.43 16206774.9 0.5744526
47     3       6          2  2008033.0 1840300.1   757330.2 0.3771503  587953.15  3485875.0 0.9164690
48     3       6          3  2755678.0 2607064.8   851433.9 0.3089744 1252059.83  4470589.3 0.9460702
49     3       6          4   726580.0  729029.3   352571.1 0.4852475  182957.97  1557213.5 1.0033710
50     3       6          5  1159637.0 1169924.9   487752.1 0.4206076  370021.56  2364837.5 1.0088716
51     3       6          6   816555.0  826608.5   384746.7 0.4711828  239817.71  1761716.1 1.0123120
52     3       6          7  1229585.0 1186172.2   451207.4 0.3669591  402957.23  2252569.4 0.9646931
53     3       6          8   560148.0  520355.9   249432.9 0.4452983  115146.29  1081272.4 0.9289615
54     3       6          9   576602.8  447822.7   260274.9 0.4513937   87495.50   969864.6 0.7766571
```

55	3	7	1	5882663.0	3159285.1	5334528.9	0.9068221	321325.99	9991116.7	0.5370502
56	3	7	2	1126338.0	883168.3	418118.2	0.3712191	235175.13	1648483.7	0.7841059
57	3	7	3	1453034.0	1171387.4	454221.5	0.3126021	392707.04	1856520.0	0.8061666
58	3	7	4	419144.0	362195.0	192403.1	0.4590382	82489.57	783419.5	0.8641302
59	3	7	5	709752.0	598837.0	264434.2	0.3725727	181638.39	1148188.9	0.8437271
60	3	7	6	458265.0	406822.1	192717.1	0.4205363	111059.15	821397.5	0.8877443
61	3	7	7	547681.4	523397.5	239449.9	0.4372066	139365.11	1045792.3	0.9556605
62	3	7	8	334529.7	326500.5	185504.9	0.5545243	78177.83	744660.9	0.9759985
63	3	7	9	501208.9	416933.9	253580.6	0.5059379	88516.73	1031943.3	0.8318566
64	3	8	1	3466915.0	5744045.9	16751041.6	4.8316851	368810.42	45654642.1	1.6568176
65	3	8	2	631414.0	581299.2	172800.4	0.2736721	300753.64	972886.3	0.9206309
66	3	8	3	835650.0	775793.6	163205.4	0.1953035	516909.68	1083028.0	0.9283715
67	3	8	4	250608.0	251050.3	109754.3	0.4379519	81099.52	527404.7	1.0017650
68	3	8	5	399780.0	415882.3	140610.7	0.3517203	184338.83	737681.3	1.0402780
69	3	8	6	341815.0	340416.2	121386.2	0.3551225	153538.78	640069.3	0.9959078
70	3	8	7	597344.9	603612.0	378723.9	0.6340121	346012.85	974031.2	1.0104917
71	3	8	8	396272.7	423475.0	219825.6	0.5547331	144332.37	907599.3	1.0686455
72	3	8	9	865307.8	933703.9	740011.2	0.8552000	311054.20	2380301.6	1.0790425

biomass

	stock	stratum	length_bin	true_bio	exp_bio	RMSE_bio	CV_bio	LR2.5	UP97.5	bias
2	1	1	2	704.7022	665.2440	245.67829	0.3486271	165.3	1162.2	0.9440073
3	1	1	3	1342.9958	1222.8841	357.48389	0.2661839	571.2	1920.9	0.9105643
4	1	1	4	509.3562	480.7715	230.29280	0.4521252	61.9	1023.6	0.9438807
5	1	1	5	977.2646	880.7978	374.40561	0.3831159	113.4	1615.3	0.9012890
6	1	1	6	831.0901	804.9798	370.88559	0.4462640	126.7	1635.4	0.9685830
7	1	1	7	1961.7952	1676.6473	797.55119	0.4065415	203.3	3220.8	0.8546495
8	1	1	8	1473.8963	1192.8935	752.53998	0.5105787	109.9	2443.9	0.8093470
9	1	1	9	3090.5890	2075.9021	1372.30312	0.4440264	243.6	3904.0	0.6716849
11	1	2	2	546.1504	891.1111	489.20271	0.8957289	272.9	1658.8	1.6316221
12	1	2	3	949.1864	1594.3044	828.27107	0.8726116	648.9	2676.0	1.6796537
13	1	2	4	314.7064	609.8170	411.33144	1.3070323	150.4	1265.4	1.9377330
14	1	2	5	578.4150	1188.8479	809.04031	1.3987194	306.0	2408.6	2.0553545
15	1	2	6	536.2641	1150.5360	805.47420	1.5020102	319.6	2317.1	2.1454652
16	1	2	7	877.9498	2075.2350	1570.43706	1.7887550	505.3	4256.7	2.3637286
17	1	2	8	490.2926	1324.1855	1115.00959	2.2741716	291.0	2926.5	2.7008064
18	1	2	9	1223.0119	2055.5973	1376.76410	1.1257161	538.8	4550.3	1.6807664
20	2	3	2	257.9074	450.4618	388.88142	1.5078337	80.1	1234.5	1.7466031
21	2	3	3	500.8869	801.3793	654.28747	1.3062578	158.3	2164.7	1.5999206
22	2	3	4	224.1155	329.5214	244.07933	1.0890785	57.5	889.0	1.4703197
23	2	3	5	500.9594	672.5587	442.98328	0.8842698	137.6	1596.6	1.3425413
24	2	3	6	498.4988	658.1976	425.12975	0.8528200	129.4	1559.2	1.3203594
25	2	3	7	973.0501	1292.7064	799.73723	0.8218870	240.5	2867.0	1.3285096
26	2	3	8	628.6183	936.6484	702.39338	1.1173606	146.5	2425.0	1.4900113
27	2	3	9	1330.7216	1470.5921	1017.14876	0.7643588	274.4	3656.3	1.1051088
29	2	4	2	617.2185	558.0503	287.99483	0.4666011	126.5	1177.7	0.9041374
30	2	4	3	1123.7044	995.0083	453.99135	0.4040131	237.8	1893.5	0.8854715
31	2	4	4	409.5970	336.1172	193.52122	0.4724674	80.6	721.3	0.8206047
32	2	4	5	807.8594	652.8442	367.56137	0.4549819	152.3	1413.1	0.8081161
33	2	4	6	795.8706	623.6559	378.34749	0.4753882	128.3	1384.9	0.7836147
34	2	4	7	1485.0560	1194.1039	653.32133	0.4399304	283.5	2431.9	0.8040801
35	2	4	8	1270.8213	952.8730	625.16817	0.4919403	204.6	2124.6	0.7498088
36	2	4	9	2520.8990	1761.4837	1203.54765	0.4774280	321.3	3893.9	0.6987522
38	2	5	2	1361.1085	1266.6200	409.92670	0.3011712	507.5	2078.5	0.9305798
39	2	5	3	2188.2372	2040.2293	564.98069	0.2581899	911.7	3293.0	0.9323621
40	2	5	4	709.2231	691.2483	247.44769	0.3488997	238.5	1239.9	0.9746557
41	2	5	5	1311.2956	1293.4205	379.76258	0.2896087	556.1	2110.7	0.9863683
42	2	5	6	1176.7196	1151.7447	377.33785	0.3206693	440.4	1964.8	0.9787758
43	2	5	7	1937.3720	1971.4999	576.47133	0.2975533	832.9	3250.9	1.0176156
44	2	5	8	1187.4878	1260.7072	483.02818	0.4067648	435.4	2364.1	1.0616591
45	2	5	9	3263.9906	2183.5869	1348.54372	0.4131580	770.2	3882.4	0.6689930
47	3	6	2	761.2854	698.0416	287.16035	0.3772046	222.9	1322.7	0.9169249
48	3	6	3	1352.8026	1276.5773	417.51084	0.3086266	612.7	2192.0	0.9436538
49	3	6	4	433.4101	434.8718	210.31150	0.4852482	109.1	928.9	1.0033725
50	3	6	5	790.4542	797.3963	332.43234	0.4205586	252.2	1611.9	1.0087824
51	3	6	6	660.4672	669.2877	311.53864	0.4716944	194.1	1426.5	1.0133550
52	3	6	7	1291.9545	1244.7601	473.61117	0.3665850	421.9	2369.1	0.9634705
53	3	6	8	838.3143	784.3103	375.06430	0.4474029	173.3	1631.8	0.9355802
54	3	6	9	2050.4870	1213.6284	1037.54668	0.5060001	235.8	2616.4	0.5918732
56	3	7	2	426.2993	334.9997	158.05438	0.3707592	89.2	625.2	0.7858322
57	3	7	3	713.8823	573.5739	223.90926	0.3136501	192.2	908.4	0.8034572
58	3	7	4	250.0224	216.0506	114.77023	0.4590398	49.2	467.3	0.8641251
59	3	7	5	483.7935	408.1591	180.24028	0.3725562	123.8	782.6	0.8436639
60	3	7	6	369.9720	329.3988	155.75139	0.4209816	89.9	665.1	0.8903345
61	3	7	7	575.7413	549.2685	251.36491	0.4365935	145.9	1100.6	0.9540196
62	3	7	8	512.7729	492.1634	280.14400	0.5463316	118.1	1120.8	0.9598078
63	3	7	9	1661.4012	1129.1611	837.31675	0.5039823	233.6	2789.2	0.6796439
65	3	8	2	239.2613	220.4938	65.47377	0.2736497	114.1	368.9	0.9215608

66	3	8	3	411.2117	379.8865	80.66553	0.1961654	253.2	530.4	0.9238222
67	3	8	4	149.4895	149.7536	65.46874	0.4379489	48.4	314.6	1.0017670
68	3	8	5	273.0141	283.4610	95.77739	0.3508148	125.7	502.8	1.0382650
69	3	8	6	277.1222	275.6310	98.29253	0.3546902	124.3	518.3	0.9946189
70	3	8	7	628.7998	633.4398	396.56037	0.6306624	363.7	1022.1	1.0073791
71	3	8	8	606.2867	638.3244	330.45146	0.5450416	217.7	1368.7	1.0528426
72	3	8	9	2830.4974	2529.3408	2026.41344	0.7159213	863.4	6268.6	0.8936029

BY STOCK & LENGTH

Total fits by length bin

numbers

	stock	length_bin	true_pop	exp_pop	RMSE	CV	bias
1	1	1	16967870	10696643	9037422.0	0.5326197	0.6304058
4	1	2	3301269	4101333	1440643.6	0.4363909	1.2423504
7	1	3	4652575	5750878	1842764.6	0.3960741	1.2360636
10	1	4	1381480	1828289	790285.3	0.5720570	1.3234278
13	1	5	2280736	3035228	1307498.8	0.5732793	1.3308106
16	1	6	1690434	2414166	1094376.0	0.6473935	1.4281338
19	1	7	2695764	3555331	1656970.8	0.6146572	1.3188583
22	1	8	1294287	1666746	891139.7	0.6885178	1.2877712
25	1	9	1435985	1568223	711066.1	0.4951767	1.0920890
2	2	1	29809355	14144650	11967587.5	0.4014709	0.4745037
5	2	2	5898813	5990365	1670703.1	0.2832270	1.0155204
8	2	3	7762039	7823600	1993977.3	0.2568883	1.0079310
11	2	4	2251332	2274718	666907.3	0.2962279	1.0103878
14	2	5	3837585	3840848	1011477.3	0.2635713	1.0008504
17	2	6	3051663	3005736	843184.0	0.2763031	0.9849502
20	2	7	4201882	4252932	1127884.4	0.2684236	1.0121494
23	2	8	2048807	2082399	696425.3	0.3399175	1.0163961
26	2	9	2229915	2029187	660461.4	0.2961823	0.9099841
3	3	1	18749189	14302962	18586237.6	0.9913089	0.7628576
6	3	2	3765785	3304768	882174.5	0.2342605	0.8775773
9	3	3	5044362	4554246	978720.0	0.1940226	0.9028388
12	3	4	1396332	1342275	416378.9	0.2981948	0.9612861
15	3	5	2269169	2184644	572362.6	0.2522344	0.9627508
18	3	6	1616635	1573847	447106.8	0.2765663	0.9735326
21	3	7	2374611	2313182	635890.0	0.2677870	0.9741307
24	3	8	1290950	1270331	380725.8	0.2949190	0.9840281
27	3	9	1943119	1798461	824416.6	0.4242748	0.9255532

biomass

	stock	length_bin	true_bio	exp_bio	RMSE	CV	bias
1	1	2	1250.8526	1556.355	547.4277	0.4376437	1.2442354
4	1	3	2292.1822	2817.189	902.1240	0.3935656	1.2290421
7	1	4	824.0626	1090.589	471.4110	0.5720572	1.3234291
10	1	5	1555.6796	2069.646	891.4739	0.5730447	1.3303804
13	1	6	1367.3543	1955.516	886.7609	0.6485231	1.4301457
16	1	7	2839.7450	3751.882	1761.3519	0.6202500	1.3212039
19	1	8	1964.1889	2517.079	1345.1999	0.6848628	1.2814852
22	1	9	4313.6008	4131.499	1943.8866	0.4506413	0.9577844
2	2	2	2236.2343	2275.132	634.2000	0.2836018	1.0173943
5	2	3	3812.8285	3836.617	976.4238	0.2560891	1.0062390
8	2	4	1342.9355	1356.887	397.8135	0.2962268	1.0103887
11	2	5	2620.1145	2618.823	689.6051	0.2631965	0.9995073
14	2	6	2471.0890	2433.598	682.8367	0.2763303	0.9848282
17	2	7	4395.4781	4458.310	1182.6781	0.2690670	1.0142947
20	2	8	3086.9274	3150.229	1057.1225	0.3424514	1.0205062
23	2	9	7115.6112	5415.663	2074.0513	0.2914790	0.7610959
3	3	2	1426.8460	1253.535	334.2590	0.2342642	0.8785357
6	3	3	2477.8967	2230.038	480.5805	0.1939469	0.8999720
9	3	4	832.9220	800.676	248.3733	0.2981951	0.9612857
12	3	5	1547.2618	1489.016	390.0912	0.2521171	0.9623558
15	3	6	1307.5613	1274.318	361.9064	0.2767797	0.9745757
18	3	7	2496.4956	2427.468	666.8973	0.2671334	0.9723503
21	3	8	1957.3738	1914.798	573.0201	0.2927494	0.9782485
24	3	9	6542.3856	4872.130	2425.6863	0.3707648	0.7447024

```
STRATUM FITS +25cm
   numbers
  stratum true_pop  exp_pop      RMSE        CV      bias
1       1 11752296 10507598 1612511.5 0.1372082 0.8940890
2       2  6980234 13412596 3232352.4 0.4630722 1.9215108
3       3  5180851  7575574 2159096.7 0.4167455 1.4622257
4       4  9900638  8218584 1665170.2 0.1681882 0.8301066
5       5 16200547 15505628 1924800.1 0.1188108 0.9571052
6       6  9832819  9327278 1463651.3 0.1488537 0.9485864
7       7  5549953  4689242  825394.3 0.1487210 0.8449156
8       8  4318192  4325233  917834.2 0.2125506 1.0016304

   biomass
  stratum  true_bio   exp_bio      RMSE        CV      bias
1       1 10891.689  9000.120 1898.5635 0.1743130 0.8263291
2       2  5515.977 10889.634 2828.9360 0.5128622 1.9741988
3       3  4914.758  6612.066 1784.2065 0.3630304 1.3453492
4       4  9031.026  7074.137 1694.3845 0.1876182 0.7833148
5       5 13135.434 11859.057 1794.2359 0.1365951 0.9028294
6       6  8179.175  7118.873 1396.4450 0.1707318 0.8703657
7       7  4993.885  4032.775  993.8803 0.1990195 0.8075427
8       8  5415.683  5110.331 2099.2199 0.3876187 0.9436171



      ____________________________________

STOCK FITS +25cm
   numbers
  stock true_pop  exp_pop    RMSE         CV      bias
1     1 18732530 23920194 3612242 0.19283260 1.2769334
2     2 31282036 31299787 3337566 0.10669273 1.0005674
3     3 19700964 18341753 1914672 0.09718674 0.9310079

   biomass
  stock true_bio  exp_bio     RMSE        CV      bias
1     1 16407.67 19889.75 3406.967 0.2076448 1.2122233
2     2 27081.22 25545.26 3045.261 0.1124492 0.9432832
3     3 18588.74 16261.98 2710.089 0.1457919 0.8748294

      ____________________________________

SNA 1 FITS (25 cm +)
   numbers
  true_pop  exp_pop    RMSE         CV    bias
1 69715530 73561733 5277652 0.07570268 1.05517

   biomass
  true_bio  exp_bio     RMSE         CV      bias
1 62077.63 61696.99 5312.779 0.08558282 0.9938684

      ____________________________________


=====================================================================
TAG RECOVERY FITS
=====================================================================
   release recovery  TagObs       TagExp       RMSE          CV
1        1        1 229.276 231.88540721  5.2982106  0.02310844
2        1        2 124.248 114.19931245 12.9084908  0.10389295
3        1        3  43.906  42.33625759  4.7655717  0.10854033
4        1        4   4.572   5.12273855  1.7105857  0.37414385
5        1        5   0.667   0.84603898  0.7427470  1.11356370
6        1        6   0.133   0.31694803  0.5217966  3.92328259
7        1        7   0.035   0.09091098  0.2614656  7.47044527
8        1        8   0.009   0.07378332  0.3186100 35.40111336
9        2        1  82.252  89.70311903 10.5940069  0.12879938
10       2        2 139.588 130.60442270 11.3892935  0.08159221
11       2        3  84.229  78.80750803  8.9583661  0.10635727
12       2        4  13.804  16.06603746  3.9423487  0.28559466
13       2        5   2.860   3.53352119  1.6495842  0.57677769
14       2        6   0.623   0.89782927  0.7850959  1.26018597
15       2        7   0.158   1.10115303  1.1296575  7.14973105
16       2        8   0.050   0.32039629  0.4478541  8.95708168
17       3        1  18.219  24.14691214  7.0423122  0.38653671
18       3        2  53.096  56.49165994  7.0910838  0.13355213
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19	3	3	97.017	101.40484736	7.4491176	0.07678157
20	3	4	45.013	59.29192509	15.4461009	0.34314755
21	3	5	12.881	19.02288970	7.1008279	0.55126372
22	3	6	3.204	4.68745721	2.2075475	0.68899736
23	3	7	0.857	1.31188795	0.9270351	1.08172121
24	3	8	0.184	0.76241658	0.7807656	4.24329104
25	4	1	3.893	3.76014750	1.5773838	0.40518463
26	4	2	17.289	14.61668964	4.1573083	0.24045973
27	4	3	90.729	76.74593335	15.4505759	0.17029369
28	4	4	161.252	159.32593734	5.3280078	0.03304150
29	4	5	67.697	67.75819342	7.0028386	0.10344385
30	4	6	17.769	18.48250789	3.5708347	0.20095868
31	4	7	5.049	5.38419054	1.7935215	0.35522311
32	4	8	1.174	2.56004930	1.8210477	1.55114793
33	5	1	1.042	1.14186622	0.8594841	0.82484079
34	5	2	6.509	5.80921180	1.9108080	0.29356398
35	5	3	47.751	44.52029121	5.4437211	0.11400224
36	5	4	124.742	123.14783045	7.7190390	0.06188003
37	5	5	234.287	233.09364054	6.0896186	0.02599213
38	5	6	77.701	79.19284947	6.7072937	0.08632185
39	5	7	24.069	25.08983842	3.4470295	0.14321449
40	5	8	5.437	5.92329115	1.8681284	0.34359543
41	6	1	0.166	0.32712640	0.5408906	3.25837689
42	6	2	1.150	1.18468922	0.8766635	0.76231606
43	6	3	9.637	8.72255380	2.2532756	0.23381504
44	6	4	27.413	26.71856286	3.6913728	0.13465775
45	6	5	65.632	64.10247857	6.3462977	0.09669517
46	6	6	122.515	119.90117323	6.0896414	0.04970527
47	6	7	55.088	55.80060490	5.6368125	0.10232378
48	6	8	13.905	13.59526162	2.4434325	0.17572330
49	7	1	0.042	0.05329933	0.1877367	4.46992078
50	7	2	0.180	0.88352567	0.8994008	4.99667123
51	7	3	1.592	1.46506494	0.9366576	0.58835274
52	7	4	4.743	4.70822571	1.7244260	0.36357285
53	7	5	12.167	12.29052298	2.9062249	0.23886126
54	7	6	33.235	33.89192731	5.1611160	0.15529159
55	7	7	137.387	138.26594407	3.6901379	0.02685944
56	7	8	57.975	57.87373762	5.3496395	0.09227494
57	8	1	0.004	0.02773546	0.1260304	31.50760609
58	8	2	0.029	0.16980688	0.2636269	9.09058429
59	8	3	0.242	0.56294679	0.5894050	2.43555779
60	8	4	0.741	1.49805283	1.1626984	1.56909372
61	8	5	1.841	1.91994696	1.2097405	0.65711052
62	8	6	5.544	5.57688744	2.0725512	0.37383680
63	8	7	38.786	39.14946088	5.1715411	0.13333525
64	8	8	183.630	178.56764726	5.9474825	0.03238840

	rec_stra	Length_bin	TagObs	TagExp	RMSE	CV
1	1	1	16.086	17.061729	2.760694	0.17162094
2	1	2	52.512	55.356199	4.990585	0.09503703
3	1	3	88.306	93.006955	6.933584	0.07851770
4	1	4	21.277	22.302303	2.787930	0.13103022
5	1	5	36.849	38.408231	3.766158	0.10220515
6	1	6	23.805	25.007642	2.964931	0.12455078
7	1	7	37.644	39.137980	3.838826	0.10197710
8	1	8	23.431	24.345066	3.162300	0.13496224
9	1	9	34.984	36.419507	3.743384	0.10700274
10	2	1	17.571	16.860914	3.183932	0.18120380
11	2	2	52.175	49.444173	5.770383	0.11059671
12	2	3	88.901	84.359668	7.829028	0.08806456
13	2	4	22.002	20.987641	3.470779	0.15774832
14	2	5	37.457	35.557395	4.759385	0.12706263
15	2	6	25.028	23.154709	3.998481	0.15976029
16	2	7	39.822	37.397359	5.069129	0.12729467
17	2	8	24.120	23.050604	3.817243	0.15826051
18	2	9	35.013	33.146855	4.628490	0.13219346
19	3	1	20.591	19.211605	3.858618	0.18739341
20	3	2	52.260	49.238480	6.461610	0.12364352
21	3	3	98.911	92.741515	9.743947	0.09851227
22	3	4	28.371	26.442403	4.388702	0.15468972
23	3	5	46.296	43.878948	5.480158	0.11837216
24	3	6	30.929	29.734719	4.012794	0.12974213
25	3	7	44.481	42.708966	4.984842	0.11206677
26	3	8	24.729	23.167752	4.072310	0.16467750
27	3	9	28.535	27.441015	4.087915	0.14325968
28	4	1	22.626	22.964666	3.353575	0.14821778

29	4	2	49.464	50.650077	5.163893	0.10439700
30	4	3	96.582	99.219933	7.415082	0.07677499
31	4	4	29.331	30.246610	3.919215	0.13362024
32	4	5	48.988	50.822782	5.334304	0.10889002
33	4	6	34.444	35.811482	4.406743	0.12793935
34	4	7	50.128	52.166925	5.342225	0.10657169
35	4	8	24.819	26.163470	3.931313	0.15839932
36	4	9	25.898	27.833366	4.161484	0.16068745
37	5	1	20.388	20.630902	3.146653	0.15433850
38	5	2	46.901	47.546356	4.818503	0.10273775
39	5	3	92.794	95.228824	7.225228	0.07786310
40	5	4	29.069	29.527364	3.557384	0.12237725
41	5	5	50.301	50.886974	4.681201	0.09306378
42	5	6	37.509	37.404453	4.083321	0.10886244
43	5	7	56.617	57.102895	4.861079	0.08585900
44	5	8	30.926	30.993448	3.616558	0.11694233
45	5	9	33.527	33.246016	3.874049	0.11555014
46	6	1	12.588	13.268863	2.842925	0.22584405
47	6	2	35.984	36.481732	4.476991	0.12441616
48	6	3	66.283	66.342086	5.526030	0.08337025
49	6	4	17.499	17.758329	3.050510	0.17432482
50	6	5	30.500	30.709617	4.003025	0.13124671
51	6	6	21.443	22.007620	3.407116	0.15889176
52	6	7	34.711	34.854984	4.175830	0.12030279
53	6	8	18.623	18.853550	3.014638	0.16187717
54	6	9	23.093	22.670798	3.307458	0.14322338
55	7	1	9.527	9.727175	2.207950	0.23175714
56	7	2	39.497	40.803133	4.392022	0.11119888
57	7	3	73.454	75.508695	5.772938	0.07859255
58	7	4	17.070	17.777723	2.897808	0.16976027
59	7	5	30.794	31.146854	3.550292	0.11529169
60	7	6	21.953	22.212248	3.079945	0.14029721
61	7	7	35.948	36.038092	4.018402	0.11178374
62	7	8	16.962	16.944433	2.719384	0.16032212
63	7	9	16.224	16.035637	2.424996	0.14946968
64	8	1	9.363	8.984681	1.874715	0.20022588
65	8	2	45.128	44.390919	3.058247	0.06776828
66	8	3	83.807	82.629736	3.967950	0.04734629
67	8	4	19.019	18.591131	1.998264	0.10506670
68	8	5	32.231	32.003989	2.484873	0.07709573
69	8	6	21.297	21.073497	2.014081	0.09457111
70	8	7	29.936	29.875978	2.501962	0.08357704
71	8	8	12.629	12.704157	1.754153	0.13889881
72	8	9	8.954	9.422494	1.832201	0.20462377

	TagObs	TagExp	RMSE	CV
1	2616.915	2616.835	36.79746	0.01406139

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PROPORTIONAL MOVEMENT FITS
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	Lb__Fr__To	true_mm	geo_obs	RMSE	CV	LR2.5	UP97.5
1	1 - 1 - 1	0.858749000	0.825703676	0.171511284	0.19972225	0.0786725000	0.960233500
2	1 - 1 - 2	0.139050975	0.145475391	0.106650886	0.76699128	0.0218681090	0.386813585
3	1 - 1 - 3	0.002199921	0.028820955	0.146452434	66.57166982	0.0001623281	0.750250241
4	1 - 2 - 1	0.150323860	0.173417967	0.101313179	0.67396606	0.0203698500	0.322511819
5	1 - 2 - 2	0.738555933	0.671255821	0.187318711	0.25362833	0.0787397000	0.861979300
6	1 - 2 - 3	0.111120437	0.155326230	0.153631510	1.38256754	0.0184028194	0.611779442
7	1 - 3 - 1	0.001321854	0.013666986	0.080411356	60.83224730	0.0002643896	0.016779579
8	1 - 3 - 2	0.177218823	0.165370245	0.071850142	0.40543178	0.0138993933	0.311727704
9	1 - 3 - 3	0.821458933	0.820962784	0.102976146	0.12535763	0.6555110700	0.973442350
10	2 - 1 - 1	0.863663500	0.848279436	0.083857892	0.09709556	0.6648992000	0.945417000
11	2 - 1 - 2	0.134116670	0.148233686	0.083363172	0.62157204	0.0509152250	0.331248671
12	2 - 1 - 3	0.002220054	0.003486875	0.002353447	1.06008534	0.0006269859	0.008086400
13	2 - 2 - 1	0.171122367	0.175766689	0.046567883	0.27213206	0.0869194464	0.256555043
14	2 - 2 - 2	0.711572533	0.711819927	0.064557975	0.09072578	0.5632199800	0.823814067
15	2 - 2 - 3	0.117304604	0.112413386	0.039869625	0.33988116	0.0531209533	0.206512953
16	2 - 3 - 1	0.001286535	0.004271821	0.003739592	2.90671630	0.0007431942	0.009394694
17	2 - 3 - 2	0.180456522	0.186201749	0.042993897	0.23825072	0.1157693757	0.292798360
18	2 - 3 - 3	0.818257233	0.809526420	0.043734243	0.05344804	0.6997171667	0.880003067
19	3 - 1 - 1	0.864165500	0.852611822	0.076715535	0.08877412	0.6747030000	0.945058500

20	3 - 1 - 2	0.133691885	0.144050323	0.076231197	0.57020063	0.0520749825	0.317029655
21	3 - 1 - 3	0.002142748	0.003337835	0.002172288	1.01378622	0.0007214731	0.007492793
22	3 - 2 - 1	0.158601927	0.174296271	0.044274127	0.27915251	0.0912760000	0.251016880
23	3 - 2 - 2	0.727094067	0.712953005	0.054696852	0.07522665	0.6026273000	0.807441667
24	3 - 2 - 3	0.114303678	0.112750729	0.030350184	0.26552237	0.0696552073	0.192750143
25	3 - 3 - 1	0.001250112	0.004092035	0.003362750	2.68995964	0.0011329441	0.008201130
26	3 - 3 - 2	0.170413280	0.173826739	0.032365627	0.18992432	0.1157761400	0.250444820
27	3 - 3 - 3	0.828336333	0.822081233	0.032946556	0.03977437	0.7426317667	0.881156500
28	4 - 1 - 1	0.856559500	0.855802678	0.070013892	0.08173850	0.6802475000	0.946907000
29	4 - 1 - 2	0.141295110	0.140587973	0.069571313	0.49238302	0.0494941421	0.314258348
30	4 - 1 - 3	0.002145239	0.003609365	0.002869770	1.33773913	0.0003753901	0.009440529
31	4 - 2 - 1	0.131129173	0.161903809	0.062156784	0.47401186	0.0687914900	0.269555717
32	4 - 2 - 2	0.761521600	0.725206529	0.085212496	0.11189767	0.5637744000	0.850692167
33	4 - 2 - 3	0.107349127	0.112889666	0.048579822	0.45254045	0.0440519729	0.238560849
34	4 - 3 - 1	0.001289106	0.004505847	0.004163677	3.22989473	0.0007178649	0.010656116
35	4 - 3 - 2	0.166752871	0.174805648	0.051177209	0.30690452	0.0962907453	0.301923037
36	4 - 3 - 3	0.831958100	0.820688513	0.052142456	0.06267438	0.6900620700	0.899125667
37	5 - 1 - 1	0.846992500	0.854378840	0.065532922	0.07737131	0.7022040000	0.938714000
38	5 - 1 - 2	0.150806710	0.142218197	0.065174784	0.43217430	0.0586179100	0.290289160
39	5 - 1 - 3	0.002200553	0.003402945	0.002375561	1.07952920	0.0005406498	0.008523956
40	5 - 2 - 1	0.118294067	0.156027733	0.064090034	0.54178571	0.0681606860	0.269317950
41	5 - 2 - 2	0.777935800	0.736178384	0.076733652	0.09863751	0.5859797333	0.846574933
42	5 - 2 - 3	0.103770180	0.107793890	0.036848154	0.35509387	0.0501624257	0.196515573
43	5 - 3 - 1	0.001322451	0.004506924	0.003953178	2.98928104	0.0008762730	0.009898932
44	5 - 3 - 2	0.165961482	0.172538488	0.041369619	0.24927241	0.1062105714	0.270082447
45	5 - 3 - 3	0.832716167	0.822954590	0.042194579	0.05067102	0.7251164667	0.890044633
46	6 - 1 - 1	0.837647500	0.850697628	0.065887349	0.07865761	0.7041460000	0.942065500
47	6 - 1 - 2	0.160107570	0.146143657	0.065672103	0.41017488	0.0559271800	0.291328050
48	6 - 1 - 3	0.002245003	0.003158726	0.002240069	0.99780226	0.0003788696	0.008382448
49	6 - 2 - 1	0.114179020	0.158287059	0.069653001	0.61003327	0.0703038467	0.274720497
50	6 - 2 - 2	0.786978667	0.739089317	0.083500901	0.10610313	0.5895439333	0.852912300
51	6 - 2 - 3	0.098842144	0.102623616	0.038501805	0.38952822	0.0434793457	0.201413313
52	6 - 3 - 1	0.001487237	0.004658513	0.004127875	2.77553342	0.0007417507	0.010956227
53	6 - 3 - 2	0.175610207	0.180044270	0.047706009	0.27165852	0.1041716433	0.295208640
54	6 - 3 - 3	0.822902233	0.815297215	0.048398667	0.05881460	0.6984352333	0.892271067
55	7 - 1 - 1	0.844123500	0.853847218	0.059594214	0.07059893	0.7171026000	0.940077000
56	7 - 1 - 2	0.153662120	0.143127873	0.059362512	0.38631845	0.0578470700	0.274695487
57	7 - 1 - 3	0.002214117	0.003024908	0.002126292	0.96033413	0.0003775546	0.008000231
58	7 - 2 - 1	0.102319653	0.146422028	0.068237100	0.66690121	0.0572807023	0.261657225
59	7 - 2 - 2	0.798281833	0.751407172	0.080370574	0.10067945	0.6097907000	0.853387767
60	7 - 2 - 3	0.099398652	0.102170802	0.036448776	0.36669287	0.0526531033	0.177880191
61	7 - 3 - 1	0.001373821	0.004229572	0.003704161	2.69624600	0.0008106355	0.010077189
62	7 - 3 - 2	0.163432494	0.171179745	0.040810708	0.24970988	0.1047659467	0.269062187
63	7 - 3 - 3	0.835193300	0.824590674	0.041696226	0.04992404	0.7258132000	0.891516167
64	8 - 1 - 1	0.852767500	0.853878019	0.067396242	0.07903238	0.6930235000	0.948811000
65	8 - 1 - 2	0.144710545	0.142190407	0.067162720	0.46411767	0.0482773950	0.304102705
66	8 - 1 - 3	0.002522037	0.003931571	0.003248450	1.28802641	0.0003262354	0.011199339
67	8 - 2 - 1	0.083600687	0.131075100	0.072710080	0.86973065	0.0475036467	0.256443516
68	8 - 2 - 2	0.822792333	0.772708062	0.083307315	0.10124950	0.6144634333	0.879997667
69	8 - 2 - 3	0.093606782	0.096216840	0.036034363	0.38495462	0.0361825820	0.177867420
70	8 - 3 - 1	0.001254936	0.005519950	0.028964649	23.08057553	0.0006173981	0.011596946
71	8 - 3 - 2	0.142892487	0.158298388	0.050074295	0.35043337	0.0780580667	0.271566903
72	8 - 3 - 3	0.855852667	0.836181666	0.057081975	0.06669603	0.7210932933	0.917391667
73	9 - 1 - 1	0.861227500	0.857249340	0.061825453	0.07178760	0.7187645000	0.944566500
74	9 - 1 - 2	0.136421415	0.138557404	0.061381955	0.44994369	0.0526611695	0.275691465
75	9 - 1 - 3	0.002351138	0.004193247	0.003590715	1.52722413	0.0004797997	0.011839413
76	9 - 2 - 1	0.094165580	0.127089698	0.057219271	0.60764529	0.0540988559	0.229650550
77	9 - 2 - 2	0.812675567	0.777759113	0.077324186	0.09514767	0.6352681000	0.880036200
78	9 - 2 - 3	0.093159383	0.095151175	0.049965978	0.53634939	0.0310808800	0.190489733
79	9 - 3 - 1	0.001271442	0.004354408	0.004152822	3.26622929	0.0006343252	0.011154826
80	9 - 3 - 2	0.143526060	0.155614328	0.046567606	0.32445401	0.0791709841	0.255665794
81	9 - 3 - 3	0.855202467	0.840031281	0.047646230	0.05571339	0.7382139367	0.915937700

Overall CV on movement
0.02201687

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GROWTH PARAMETER FITS
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	parameter	observed	expected	RMSE	CV	LR2.5	UP97.5
1	mu_Alpha	5.47	5.4047344	0.07481315	0.01367699	5.332990	5.476690
2	mu_Beta	2.89	2.8620908	2.60822311	0.90249935	2.805200	2.933450
3	theta	1.00	0.9944048	4.47560922	4.47560922	0.961544	1.000000
4	omega	0.80	0.8021000	4.66790121	5.83487651	0.795272	0.808667