Final poaching trends using the new approach to combine estimates of illegally exported and locally sold west coast rock lobster

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Summary

A new approach which combines TRAFFIC and Compliance poaching indices to provide an overall trend for poaching in absolute terms is proposed. This incorporates penalties on options that imply negative values for local sales of poached lobster, and large changes in the amount poached from year to year. The approach is applied to these indices separated by North and South areas. Four options for overall poaching trends are put forward, with the intent that they bound the range considered plausible.

Key words: West coast rock lobster, poaching trends

Introduction

This document outlines a suggested new approach to combining the TRAFFIC and Compliance poaching index series to provide an aggregated trend for overall poaching in absolute terms. Initially this approach was developed for the resource as a whole, but is expanded here to split total poaching trends between the North and South (A8+) areas, as these two areas show different compliance poaching index trends.

Information available

C_y Annual compliance-based **index** of poaching for each of the North and South areas. This trend is assumed to apply to the combination of illegal local sales and exported lobsters [2009-2020].

T_y TRAFFIC-based estimates of illegally exported lobster [2001-2020]. The TRAFFIC estimates are split 0.30:0.70 between the North and South areas.

L_y Annual locally sold poached lobster [2009-2020] [These values are to be **estimated**].

P_y Total annually poached lobster (exported and locally sold added together) for each of the North and South areas [2008-2020].

Assumptions

1) P_y is roughly proportional to C_y, i.e. $P_y = k.\ C_y$+error.

   Thus $k = \frac{\sum_{2009}^{2020} P_y}{\sum_{2009}^{2020} C_y}$.

   Also $P_y = T_y + L_y$

2) A fixed value of locally sold poached lobsters L_{2020} is used for input. Here we set $L_{2020} = 850$ mt and 200 mt. These relate to the Total local sales estimate, and these are again split 0.30:0.70 between the North and South areas.

Furthermore

3) L_y should not be negative.
4) P_y should not change too much from year to year.

Estimable parameters: $L_{2009}, L_{2020} \ldots L_{2019}$ (11 estimable parameters).

The values of the estimable parameters are obtained by minimising the following function:

SS=SS1 + SS2 + SS3

$$SS = w1 * \sum_{2009}^{2020} \left(P_y - kC_y\right)^2 + w2 * \sum_{2009'}^{2020'} {L_y}^2 + w3 * \sum_{2009}^{2020} [P_y - P_{y-1}]^2$$

where $\sum_{2009'}^{2020'} {L_y}^2$ is summed only for those years for which L_y is negative.

The weights w1, w2 and w3 can be varied to see what form of P_y trajectories result.

Note:

By increasing w2, the Local Sales trajectory is pushed higher, so that negative values are kept increasingly small.

By increasing w3, the overall poaching trend is "smoothed" over time.

Further statistics

Plots of the residuals (difference between P_y and $k.C_y$) are produced, along with the SS1 value of $w1 * \sum_{2009}^{2020} \left(P_y - kC_y\right)^2$.

An AAV (annual average variation) statistic is calculated to represent the average fluctuation in the poaching estimates.

where $AAV = \frac{\sum_{2009}^{2019} |P_{y+1} - P_y| / P_y}{11} * 100$

Results

Preliminary results were presented to the poaching Task Team on 19 July 2021. These initial results were at the "whole coast" scale, and this document expands this method to model the North and South areas separately (as the compliance trends are different for these two areas).

It was agreed that for results presented in this document the weights of w1=1, w2=5, w3=0.5 should be assumed as these seemed to reflect reasonable compromise weightings. Some statistics are provided for the w1=1, w2=0, w3=0 weighting for comparative purposes.

Two levels of total 2020 local sales are explored – these being 850mt and 200mt. Note that 850mt is split between North and South as 255mt and 595mt, and 200mt is split as 60mt and 140mt.

A recent document (FISHERIES/2021/JUL/SWGTT/WCRL08) provided results of residual analyses and a further sensitivity to "outlier" omission of the model to obtain Compliance poaching trends for West Coast rock lobster. The Task Team recommended that the Base Case be used for both the North and the South, but that the Sensitivity for the South for which outliers are omitted also be explored.

Table 1 and Table 2 reports results of the SS1 and AAV statistics respectively for North and South (and 850mt and 200mt L(2020)) for the two weighting scenarios: w1=1, w2=0, w3=0 and w1=1, w2=5, and w3=0.5.

Table 3a reports the final estimates of combined local and exported poached lobster (mt) for the North, South and Total (North+South). The South has two different compliance trends (BC and SEN), with these values being presented graphically in Figure 4a.

Table 3b reports the final estimates of implied locally sold poached lobster (mt) (P(y)-T(y)) for the North, South and Total (North+South). The South has two different compliance trends (BC and SEN), with these values being presented graphically in Figure 4b.

Discussion

This approach is attractive is being able to produce smoother trends over time and reducing the extent of implied negative numbers of poaching lobsters sold locally in certain years.

The Task Group needs to confirm whether the options for poaching trends listed in Table 3a and shown in Figure 4a constitute a sufficient set for initial use in assessments, so as to check how sensitive important outputs from those assessments might be to choices amongst these and intermediate options.

Table 1: The SS1 statistic (which measures the goodness of fit to the compliance trend).

	L(2020)	Compliance Trend	w1=1, w2=0, w3=0	w1=1, w2=5, w3=0.5
NORTH	850	BC	0	9.8×10^4
	200	BC	0	4.9×10^4
SOUTH	850	BC	0	140×10^4
	200	BC	0	2050×10^4
	850	SEN	0	40×10^4
	200	SEN	0	78×10^4

Table 2: The AAV statistic (which measures the smoothness of the poaching trajectory). In the last column of results, the figures in parentheses are the proportional reductions relative to the first column of results.

	L(2020)	Compliance Trend	w1=1, w2=0, w3=0	w1=1, w2=5, w3=0.5
NORTH	850	BC	38.29	24.75 (0.65)
	200	BC	21.70	17.42 (0.80)
SOUTH	850	BC	36.68	14.91 (0.41)
	200	BC	37.20	17.50 (0.47)
	850	SEN	26.20	13.48 (0.51)
	200	SEN	27.61	13.68 (0.50)

Table 3a: Estimates of combined local and exported poached lobster (mt) for the North, South and Total (North+South). The South area has two different compliance trends (BC and SEN).

	North	North	South BC compliance	South BC compliance	South SEN compliance	South SEN compliance	Total BC compliance	Total BC compliance	Total SEN compliance	Total SEN compliance
	850mt	200mt	850mt	200mt	850mt	200mt	850mt	200mt	850mt	200mt
2008	537	537	1252	1252	1252	1252	1789	1789	1789	1789
2009	750	702	820	810	880	860	1571	1511	1631	1562
2010	712	660	836	823	896	872	1548	1483	1609	1532
2011	605	561	711	698	783	749	1316	1259	1388	1310
2012	377	356	725	706	934	764	1102	1063	1311	1121
2013	311	307	724	703	1157	903	1034	1011	1468	1210
2014	335	332	798	776	1285	993	1133	1109	1620	1326
2015	295	293	683	663	1264	974	977	956	1559	1267
2016	223	221	549	517	1096	840	772	738	1319	1062
2017	189	189	499	467	907	687	688	657	1096	877
2018	165	163	538	423	742	544	703	586	907	707
2019	178	138	866	636	818	554	1044	775	996	693
2020	360	165	840	385	840	385	1200	550	1200	550

Table 3b: Estimates of the implied local sales (P(y)-T(y)) of poached lobster (mt) for the North, South and Total (North+South). The South area has two different compliance trends (BC and SEN).

	North 850mt	North 200mt	South BC compliance 850mt	South BC compliance 200mt	South SEN compliance 850mt	South SEN compliance 200mt	Total BC compliance 850mt	Total BC compliance 200mt	Total SEN compliance 850mt	Total SEN compliance 200mt
2008	0	0	0	0	0	0	0	0	0	0
2009	358	309	-95	-106	-35	-55	263	204	323	254
2010	294	241	-140	-153	-80	-104	154	88	214	138
2011	261	217	-92	-105	-19	-53	169	112	241	164
2012	48	27	-43	-62	166	-3	5	-34	214	24
2013	-9	-12	-22	-42	411	157	-31	-54	403	145
2014	-25	-27	-42	-64	445	153	-67	-91	420	126
2015	-15	-17	-41	-60	541	250	-56	-78	525	233
2016	-5	-6	18	-15	565	309	12	-21	560	302
2017	-21	-21	8	-23	416	197	-13	-44	396	176
2018	-11	-13	127	12	331	133	116	-2	320	120
2019	35	-4	534	305	486	222	569	301	522	219
2020	255	60	595	140	595	140	850	200	850	200

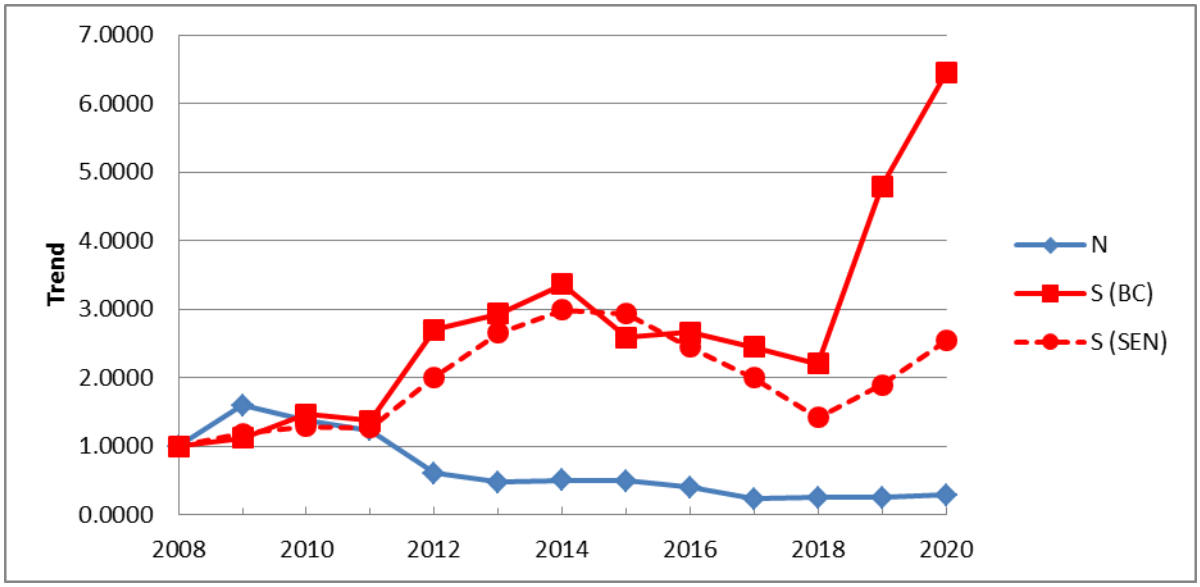

Figure 1: Compliance trends for the North and South (3-pt smoothed trends are shown).

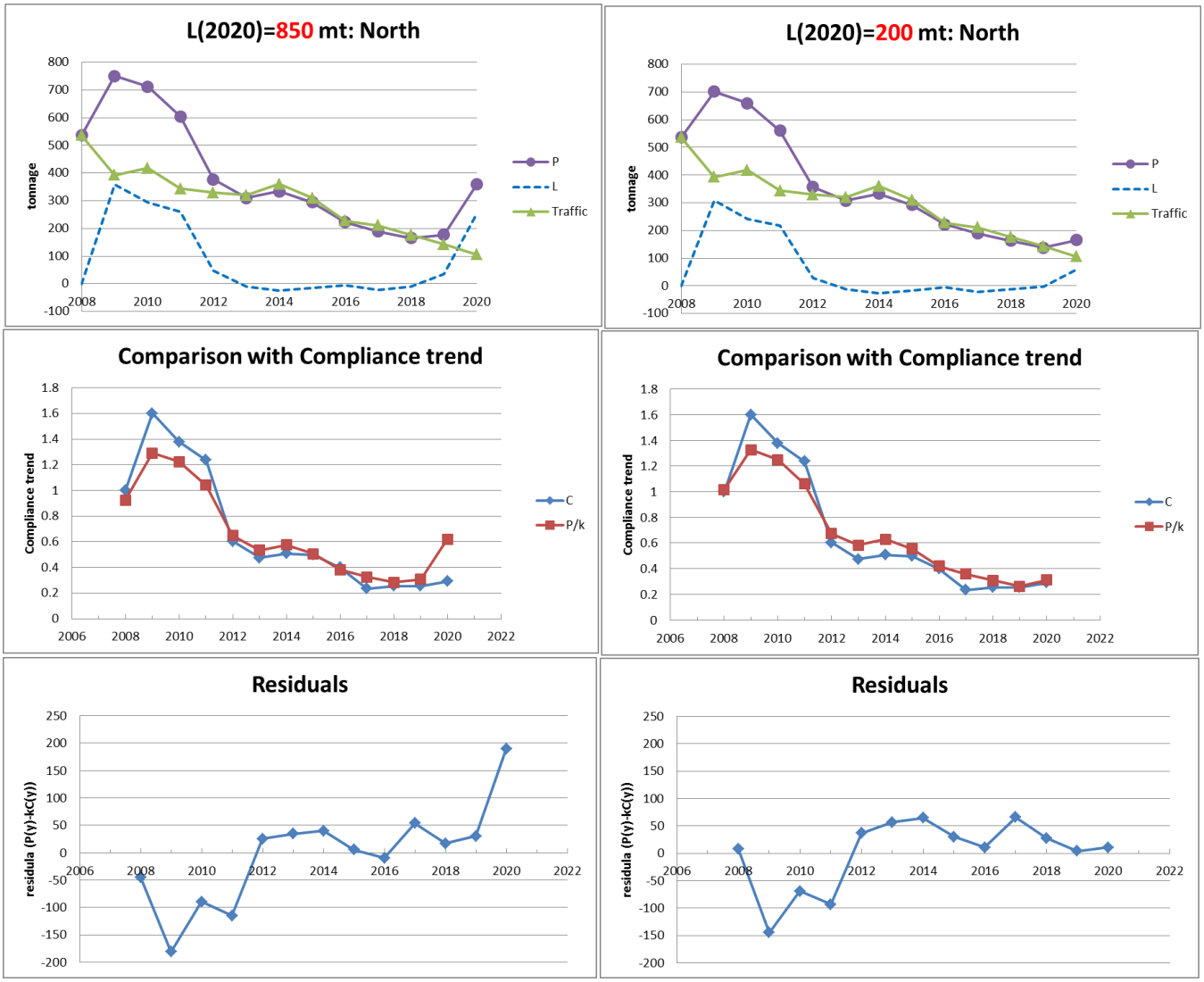

Figure 2: Poaching trajectories for the **North** for a total (i.e. North and South combined) L(2020) of either 850mt or 200mt. The top plots show the final poaching trend for the North, along with the proportions of the TRAFFIC estimates assumed to apply to the North and the estimated local sales for the North (L). The middle plots show the comparisons of the poaching trend with the compliance trends, and the bottom plots show the residuals for those comparisons.

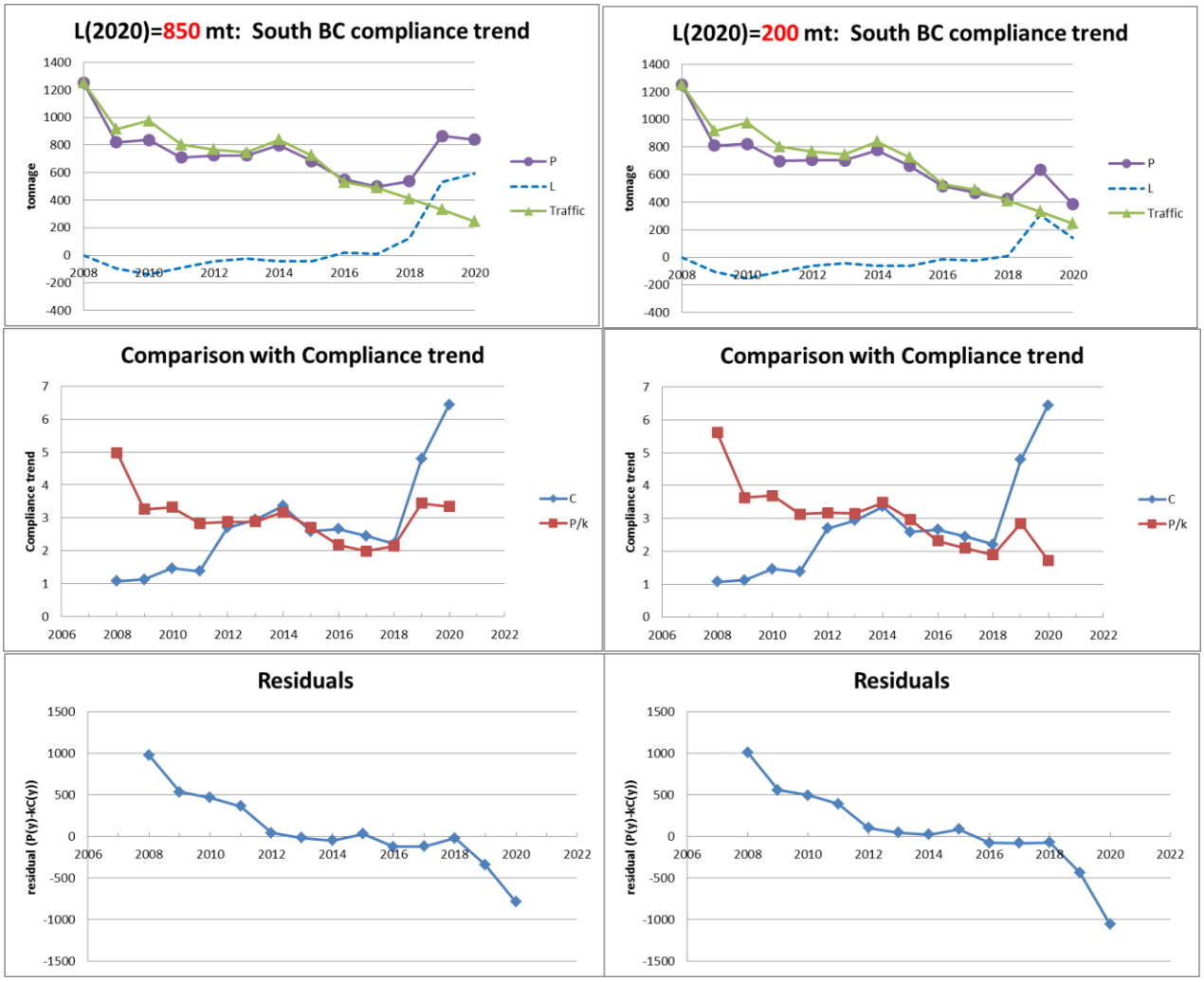

Figure 3a: Poaching trajectories for the **SOUTH** for a total (i.e. North and South combined) L(2020) value of either 850mt or 200mt. Results are presented assuming the **BC compliance** trend. The top plots show the final poaching trend for the South, along with the proportions of the TRAFFIC estimates assumed to apply to the South and the estimated local sales for the South (L). The middle plots show the comparisons of the poaching trends with the compliance trend, and the bottom plots show the residuals for those comparisons.

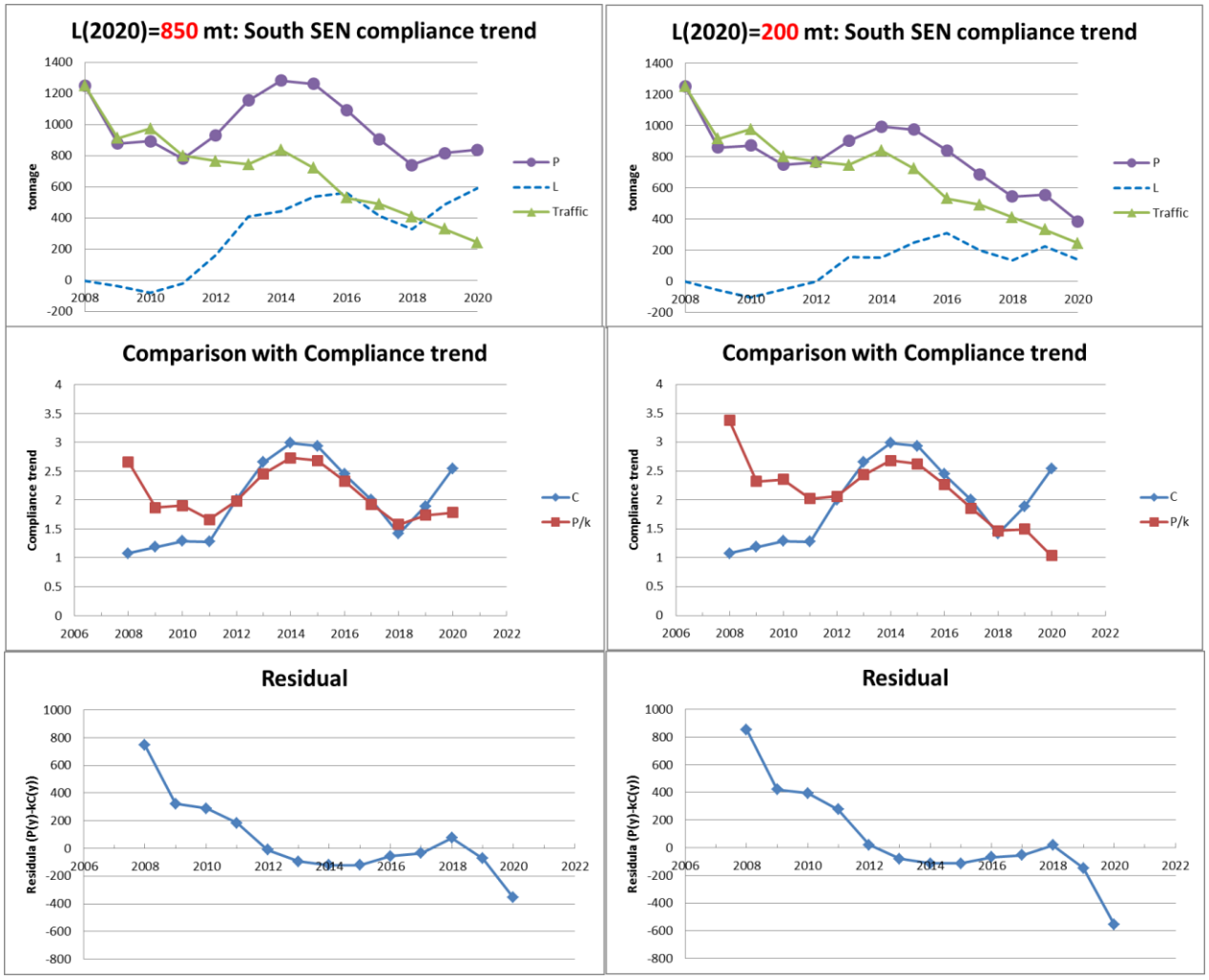

Figure 3b: Poaching trajectories for the **SOUTH** for a total (i.e. North and South combined) L(2020) value of either 850mt or 200mt. Results are presented assuming the **SEN compliance** trend. The top plots show the final poaching trend for the South, along with the proportions of the TRAFFIC estimates assumed to apply to the South and the estimated local sales for the South (L). The middle plots show the comparisons of the poaching trends with the compliance trend, and the bottom plots show the residuals for those comparisons.

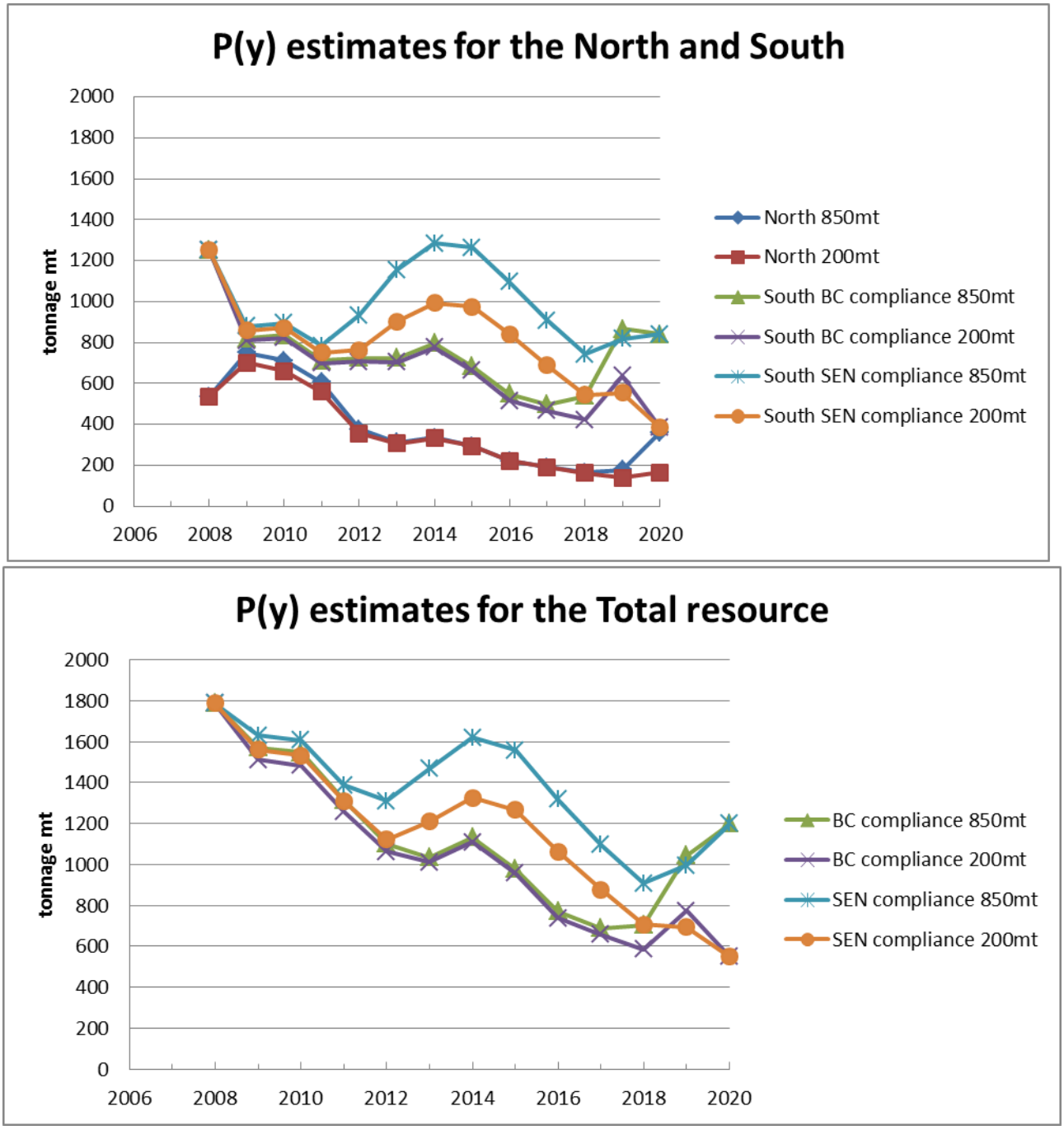

Figure 4a: Poaching P(y) estimates for the North and South (top plot) and the total resource (bottom plot). Results are for 850mt or 200mt for L(2020), and two compliance trends applicable to the South.

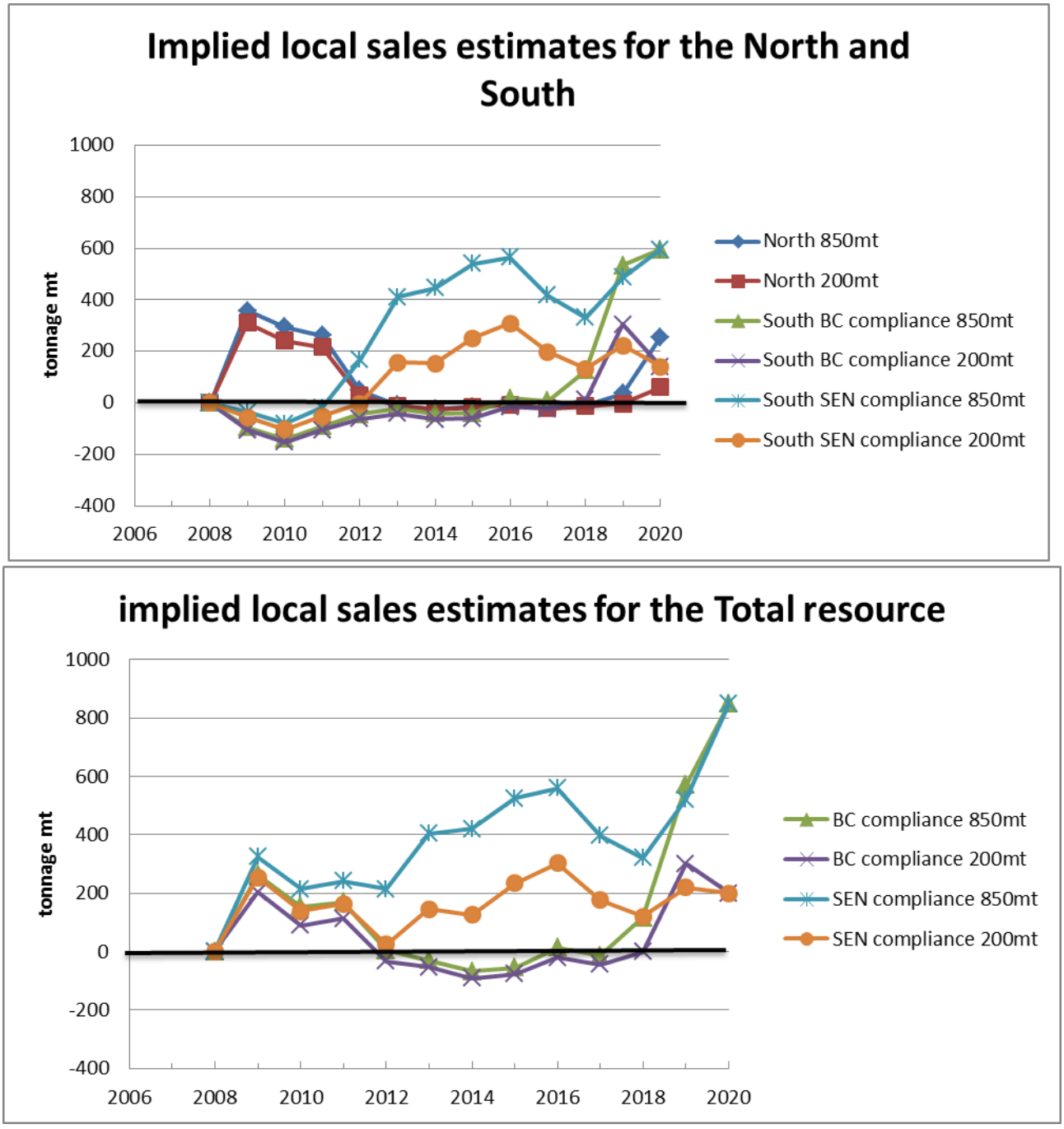

Figure 4b: Implied local sales estimates (P(y)-T(y)) for the North and South (top plot) and the total resource (bottom plot). Results are for 850mt or 200mt for L(2020), and two compliance trends applicable to the South.