Appendix B: Case Studies on the potential impacts of new deemed value policies

For many fish stocks, operation of the deemed value regime should be relatively straight forward and poses relatively few risks. For species which are primarily target catch, and for which there is reasonably good information for setting the TAC, deemed values set a little above ACE prices should provide sufficient incentives to keep catches within the TACC. Return of deemed values to quota holders should not pose any serious risks in these cases, since deemed values will still provide appropriate incentives, at the individual level, to balance catches with ACE.

There are, however, cases where significant use of deemed values to balance catches is likely to occur. In some of these cases this may be acceptable, at least in the short run. In other cases a strong response to curtail overcatch may be required. There may also be cases where return of deemed values to quota holders could create perverse incentives (though not necessarily actions) to deliberately utilize deemed values to exceed individual ACE allocations and the TACC. Therefore it may be necessary to have safeguards to prevent abuse of the deemed value system.

We utilize a series of case studies to illustrate how deemed value policies should be used in different types of fisheries, problems that have arisen or might arise and appropriate responses to those problems. Each of the following case studies begins with a description of the key characteristics of the fishery in question followed by a discussion of how deemed values have been and are likely to be used and/or potentially abused. The case study then outlines policies for setting and adjusting deemed values for that fishery and the risks and benefits of those policies. Each case study discusses how managers would be expected to respond to significant TACC overruns. In addition, each case study addresses the question of how return of deemed values to quota holders would affect the incentives created by deemed values and whether this would create additional risk that might require compensatory actions. All of the case studies consider responses to current situations. Some of them also address the response to hypothetical problems that might arise.

The species/stocks discussed in the case studies are chosen to illustrate a range of different characteristics that we expect to affect the operation of the deemed value regime and the potential problems that may arise. They include species/stocks that are: target or non-target, commercial or shared, high value or low value, high productivity or low productivity. We also discuss how shelving of quota would affect deemed value policies.

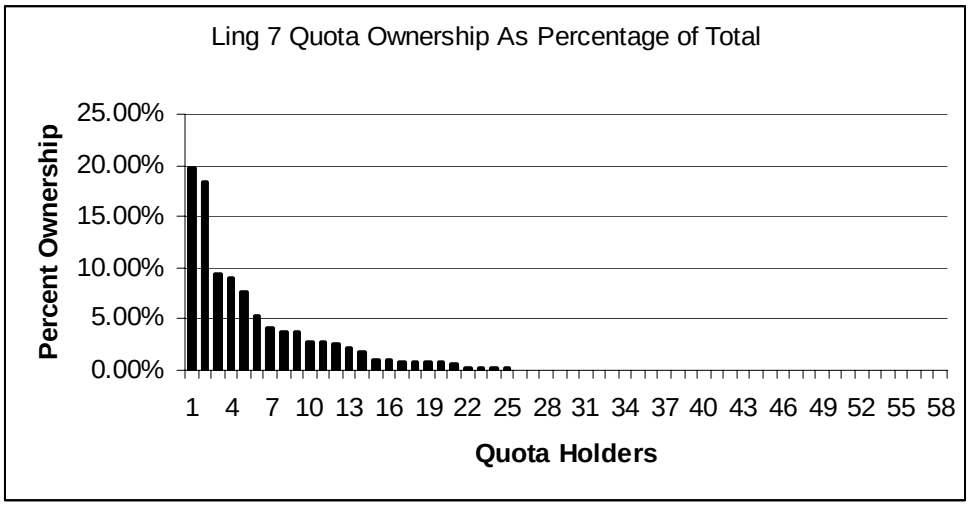
In each case we make the assumption that deemed values will in future be returned to quota holders in proportion to quota holdings.

Case Study Stocks

1) Mixed target-incidental catch fishery – LIN7
2) Shared commercial-recreational fishery – KIN8
3) Medium value target species with very low productivity or high biological risk – ORH3B
4) Incidental catch species with low information and low biological risk – SPE4
5) Incidental catch species with low information and some potential biological risk – GSH3

Case Study: LIN7

1. Characteristics:
   1.1. *Target/Bycatch:* Mostly bycatch of hoki fishery but some targeted catch by inshore vessels. Target catch generally less than 20%.
   1.2. *Value:* Medium value fish. The MFish port price for 2004 was $2.56. The stock has had a high shadow value as bycatch. Because there is insufficient LIN7 ACE to cover bycatch in the hoki fishery and bycatch rates relative to hoki catch are low enough that deemed values well above port price might not provide sufficient incentive to avoid incidental catch. This is evidenced by significant use of deemed values even when differential deemed values are well in excess of landed value.
   1.3. *Live return/legal discard:* Can not be returned live or discarded at sea.
   1.4. *Commercial/Shared:* Commercial fishery with only nominal allowance for recreational or customary catch.
   1.5. *Biological productivity and risk*: Productive, long lived species with fishery based on multiple cohorts. Some risk of failure to rebuild at low stock levels, but enough information should be available to avoid collapse. Data quality should be good as most catch is taken by large vessels that supply tow-by-tow catch and effort data. Some anecdotal evidence of local depletion.
   1.6. *Stock status:* There is a relatively high level of uncertainty about the status of the LIN 7WC stock. The fishery may be fully developed as current stock size is estimated to be about B_{MAY}. Model results indicate that future catches at the current TACC level appear to be sustainable, but higher catches at the current actual catch level may cause a decline in biomass over the next 5 years.
   1.7. *Nature of quota ownership and control:* Quotas ownership is relatively concentrated with two quota owners owing close to 20% each and another four quota owners with 5-10% each.



2. *Historical and future use of deemed values*
   2.1. *Historical use:* Catches for this stock have been 30-50% over the TACC for this species for at least the past nine years. The TACC has remained the same over this period. These significant overcatch persisted despite increases in the deemed value to a level around the port price and use of differential deemed values. Catch in 2002/03, at 30% above the TACC, was at the lowest level in the last nine years. Catch in 2003/04 was 31% above the TACC but only 29% above available ACE due to carry forward from the last year.
   2.2. *Expected or potential future use:* It appears that, for the near future at least, significant use of deemed values is likely to decline significantly and may be eliminated. This would be due primarily to a reduction in hoki catches in the LIN7 QMA. However, if the hoki TACC is increased again in the future, and the LIN7 stock remains at present levels or increases, one

could expect overcatch of LIN7 to occur again. This could be compounded if the current TACC allows the LIN7 stock to build from its present size.

3. *Deemed Value Policy*
   - 3.1. *Present policy:* Deemed value is now $2.21 which is probably close to the landed value. The port price in 2003 (based on 01/02 sales) was $2.21 while the port price in 2004 (based on 02/03 sales was $2.56). No information is yet available on prices during the 03/04 fishing year.
   - 3.2. *Relevant information of setting deemed value:* The ACE market is limited since most quota is held by large vertically integrated firms using it on their own vessels to cover bycatch in the hoki fishery. Ace transfers accounted for over 100% of the catch, but most of these may have been internal transfers. The average ACE price in the 2003-2004 was $1.40 with a high of $3.09. In 2002-03, the average ace price was $1.16 but the high was $3.33. The last available port price is $2.56. Catch has been declining in the last two years, and there is strong reason to believe that incidental catch will decrease dramatically in the 04/05 fishing year. Since some quota owners have 20% of the total quota, deemed value would have to be at least 20% over ACE price to eliminated incentives for them to cover catch with deemed values if they were getting a return of deemed values proportional to quota ownership.

     While all the above information may be relevant for setting deemed value, the most important information may not be directly observable when overcatch is occurring. In this case is may be useful to attempt to determine the shadow value of LIN7 as a constraint on use of hoki catch. A maximum shadow value could be calculated by dividing the value of hoki ACE by the ling-to-hoki proportional catch rate. That should be roughly equal to the opportunity cost of forgoing using hoki ACE to avoid catching LIN7. Actual shadow value may be lower if ling catch rates can be reduced by altering fishing methods or gear. Current information to calculate this maximum shadow value has not be compiled but relative bycatch rates of LIN7 for hoki were around 2% in 2001-2003. With a hoki ACE price of $0.32, this yields a shadow value of around $16.

   - 3.3. *Proposed general basis for setting deemed value (not overcatch situation):* Set deemed values at 10-20% above the 90th percentile ACE price from the previous year.
   - 3.4. *General response to overcatch:*
     - 3.4.1. *Temporary overcatch:* Raise deemed value to around the landed value of catch when taken as bycatch (this may differ from port price if port price reflects targeted catches that are handled differently).
     - 3.4.2. *Chronic overcatch:*
       - 3.4.2.1. Review Ling TACC. If decision is not to raise it, go to 3.4.2.2
       - 3.4.2.2. Review Hoki TACC and industry agreement on the split of hoki catch between areas. If decision is not to attempt to lower hoki catch in the LIN7 area, go to 3.4.2.3
       - *3.4.2.3.* Review Deemed Value. In cases where there has been persistent overcatch it may be more relevant to consider what the current deemed value is relative to port price as opposed to what the ACE price is since ACE price will presumably be driven by deemed value. It would also be useful to attempt to determine the shadow value of LIN7 as a constraint on the hoki fishery. In such a case, with a bycatch stock, you would probably want to set deemed value at or above port price to take away any incentives to target the stock without ACE. If overcatch is thought to be threatening viability or if a significant proportion of quota owners (the proportion should probably be higher than the 5% now required under 14b) don't want to see the TACC raised, it will likely be necessary to set deemed value above port price, but concern should be given to whether this will result in unreported discards. There should be a compliance response if deemed value is well above port price and a signal that compliance will be closely monitored.

3.4.2.4. If deemed values appear ineffective at limiting catch, it may be necessary to use other management measures. As a last resort, overfishing thresholds could be imposed.

3.5. General response to undercatch: set deemed value at 20% above the 90th percentile ACE price from the previous year unless there are factors that suggest the ACE price is likely to change. Factors would include changes in the port price, the TACC of LIN7 stock, the expected hoki catch in the LIN7 areas. Also may need to adjust for changes in quota concentration.

3.6. Appropriate Response to current situation: This stock is primarily an incidental catch fishery, is not a shared fishery and is not a low productivity species that poses particular biological risk. There is a stock assessment on this stock which indicates that its viability is not threatened at this point. Catch is expected to fall next year. Therefore the deemed value need not be raised. However, if the Hoki TACC had not been dramatically dropped, it might have been necessary to increase the deemed value.

4. Risks and Special Concerns

4.1. Biological-ecological risk: Not a species with particular biological risk associated with low productivity. There could be issues with local depletion.

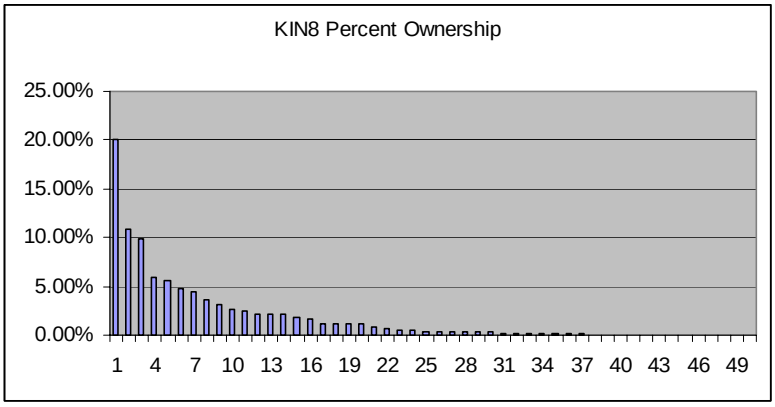
4.2. Deliberate overfishing: Because this fishery is primarily a bycatch fishery, it is possible that the optimal TACC, from the perspective of at least some quota owners, would allow the stock to decline below the level that would produce MSY. There has clearly been deliberate catch in excess of available ACE for this stock in the past (despite ramped deemed values not returned to quota holders). This has apparently been due to the fact that LIN7 ACE availability constrained the highest value use of Hoki ACE to the extent that it was worthwhile paying deemed values. Nevertheless, there is little reason to believe that quota holders would conspire to utilize deemed values to create an unofficial TACC increase. The overcatch in the past has not been at all proportional to quota holdings. While there are a few companies with around 20% of quota each, there is a reasonably large number of quota owners with disparate percentage ownership and apparently disparate interest in exceeding ACE. The benefits from overcatch of ACE are related primarily to a lack of balance with hoki quota for some companies, but the imbalance and thus the benefits of overcatch vary greatly across players. The two largest quota owners have not been exceeding their ACE and would have little apparent reason to agree proportional overcatch and strong incentives to defect from such an agreement. It would require a very complex agreement to equalize net benefits of overcatch across all parties. Finally, the largest quota holder has consistently resisted seeking a TACC increase for LIN7. In sum, individual overcatch might be expected as long as the benefits from it exceed the net deemed value after rebate. The focus should be on ensuring that the deemed value is still an effective deterrent at the individual level.

4.3. Impacts on other stakeholders: There are no significant impacts on customary or recreational stakeholders.

Case Study: KIN8

1. *Characteristics*:
   1.1. *Target/Bycatch:* Kingfish commercial landings are reported largely as non-target catch of inshore setnet, trawl and longline fisheries. From 1991 to late 2003, targeting of kingfish (as a non-QMS species) was prohibited unless the species was identified on a fishers permit. A few permit holders were authorized to target kingfish and most of their catch was taken using set nets. The majority of the KIN8 catch in the last few years has apparently been taken as a bycatch in the JMA7 fishery.
   1.2. *Value:* Commercially, kingfish is a moderately high value species and is usually sold as fillets or whole chilled. In recent years about one quarter of the commercial catch has been exported, the main markets being the United States and Australia. The current MFish port price for KIN8 is $3.81. However, the value of ACE for KIN8 is probably well in excess of that. The TACC KIN8 was set well below the commercial catch of 143 tonnes in the year before introduction to the QMS and about 20% below the average for the reported catch over the past 20 years which is likely to be an underestimate. The TACC appears to be a serious constraint on the JMA7 fishery and may be constraining inshore finfish fisheries as well. Because the catch rates of KIN8 when targeting JMA7 are very low, the shadow value of KIN8 as a constraint on use of JMA7 quota may be quite high. Reported ACE trade prices in 2003-04 ranged from $3 to $6 per kilo. However, judging by the fact that many vessels targeting JMA7 were paying deemed values in excess of $17 per kg (differential deemed values of 200% of annual deemed value) it would appear that ACE would have been valued considerably above $6 by some companies.
   1.3. *Live return/legal discard:* No discarding, alive or dead, is allowed.
   1.4. *Commercial/Shared:* This is a shared fishery. The TACC is 39 tonnes which is less than 44% of the TAC.
   1.5. *Biological productivity and risk*: Biological information on the growth, reproduction and longevity is limited hence the stock productivity of kingfish is incomplete. However this is a relatively long-lived and fecund species without any known characteristics that would suggest particular biological risks. The stock structure suggests that while local depletions could occur, but there is little reason to believe that stocks in the QMAs are really separate. [The stock structure of New Zealand kingfish is unknown. Tagging results suggest that most adult kingfish do not move outside local areas, with many tag returns close to the release site. However some tagged kingfish have been found to move very long distances; there are validated reports of New Zealand tagged kingfish being caught in Australian waters and Australian tagged kingfish being recaptured in New Zealand waters.]
   1.6. Stock status: Unknown
   1.7. *Nature of quota ownership and control:* Quotas ownership is not heavily concentrated but the number of quota owners owning a significant quantity by weight is low due to the small TACC. There are around 50 quota but only 10 owning over 1 tonne (of the total 39 tonne TACC). The largest quota owner (TOKM) owns 20% and two other quota owners with 10% each. It is unclear how distribution of TOKM holdings might affect this but presumably

ownership of that 20% will become dispersed.



2. *Historical and future use of deemed values*
   - 2.1. *Historical use:* In its first year in the QMS, catch exceeded the TACC by approximately 18 tonnes (57% of the TACC). Much of that overcatch will attract the maximum differential deemed value of $17.80 per kilo. Total deemed value is likely was in excess of $300,000 which is well in excess of the landed value of the catch.
   - 2.2. *Expected or potential future use:* It seems likely that catch could continue to exceed the TACC unless jack mackerel catch is reduced.
3. *Deemed Value Policy*
   - 3.1. *Present policy:* This stock was only introduced to the QMS in 2003. The deemed value was set at $8.90 which was 200% of port price. It was put in the "high value" category although it is mostly taken as bycatch. A differential deemed value was applied. The deemed value was not changed in 2004. Current deemed value policy could lead to an increase in 2005 due to overcatch of the TACC.
   - 3.2. *Relevant information of setting deemed value:* Overcatch, Port price, ACE price, shadow value as bycatch in JMA7 fishery and inshore finfish fisheries. ACE price ranged from $3-6 per kilo in 2003-04 with and average of $3.86. Port price is $3.81 but this probably has little relevance in setting deemed values at the present time. Probably the most relevant information is whether the previous year's deemed value was effective at constraining catch. It appears that it was somewhat though not fully effective in that catch in 2003-04 dropped by over 60%. It appears that at least the differential deemed values must have provided some deterrent. It is not possible to know how effective the annual deemed value of $8.90 would have been without the differential applied. However it seems likely that a somewhat higher annual deemed value would have been required to achieve the same catch reduction if differential deemed values were not applied.

     The proportion catch rate of KIN8 to JMA7 is around 0.0025. A maximum shadow value derived by dividing the value of JMA ace (which ranged from $0.015 to $0.14 per kilo) by this catch rate yields are potential range of shadow values from $6-$56 per kilo. At the average JMA Ace price of $0.023 the maximum shadow value would be $9.20.

   - 3.3. *Proposed general basis for setting deemed value (not overcatch situation):* Set deemed values at 20% above the 90th percentile ACE price from the previous year.
   - 3.4. *General response to overcatch:*
     - 3.4.1. *Temporary overcatch:* Raise deemed value to slightly below the landed value of catch taken as bycatch (this may differ from port price if port price reflects targeted catches that are handled differently).
     - 3.4.2. *Chronic overcatch:*
       - 3.4.2.1. Review TACC. If decision is not to raise it, go to 3.4.2.2

3.4.2.2. Review TACC of target species responsible for overcatch. If decision is not to lower that TACC (or catch through voluntary methods), go to 3.4.2.3

3.4.2.3. Review Deemed Value. Raise to level that will be effective deterrent but keep in mind incentives for discarding that will be created. If deemed value is set well above port price, a compliance response and signal may be needed. If deemed values are ineffective due to the high shadow value of catch go to 3.4.2.4

3.4.2.4. Consider other management measures to reduce catch. As a last resort, overfishing thresholds should be imposed

3.5. General response to undercatch: Set deemed values at 20% above the 90th percentile ACE price from the previous year.

3.6. Appropriate Response to current situation: Catch has fallen over 60% from the previous year. The very high deemed values paid by some individuals may induce behavioral changes in the upcoming year. One would expect any deliberate or passive targeting of kingfish would be reduced or eliminated. The drop in catch may also be a signal that the high catch in the previous year may have been due to chance or a pulse in abundance. It would not be appropriate to reduce the deemed value, but since the deemed value is already nearly twice the port price, it may not be necessary to raise it. However, if differential deemed values were removed it might be necessary to increase the annual deemed value so that the effective deemed value was not reduced. If the catch in 2004-2005 remains well above the TACC and a TACC increase is not feasible, deemed values might have to be raised in 2005-06.

4. Risks and Special Concerns

4.1. Biological-ecological risk: No special biological or ecological risks. There is evidence of local depletions which could negatively impact recreational fishers.

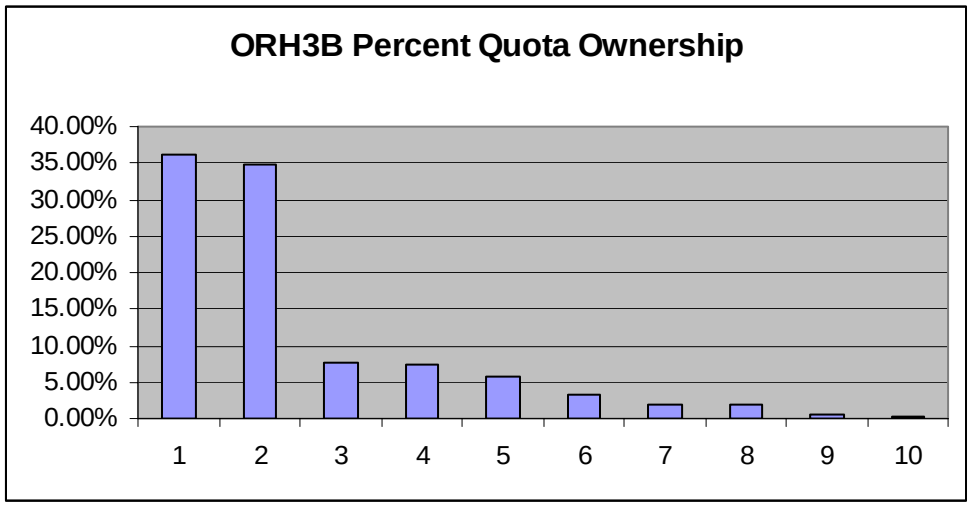
4.2. Deliberate overfishing: Despite the fact that some quota owners might prefer to see an increase in the TACC even if it led to depletion of the fish stock, there are reasons to doubt that quota owners would or could conspire to overfish the TACC deliberately without penalty (enabled by return of deemed value). The ownership of quota is not concentrated and the apparent interests of quota owners are heterogeneous in that some have adequate quota to cover catch while others do not. Any quota owners that view quota as an asset, rather than purely as a means of covering bycatch, would have the incentive to keep catch constrained to keep the stock high. This would keep both the target and the shadow value of kingfish high. The focus should be on whether the individual deterrent is sufficient.

4.3. *Impacts on other stakeholders:* This is a shared fishery. Recreational fishers are impacted by commercial overcatch. Thus, even though the viability of the kingfish stock may not be threatened and allowing the stock to decline might provide the greatest overall commercial benefits (by reducing constraint on other fisheries), it may be necessary to constrain catch to the TACC.

Case Study: ORH3B

1. *Characteristics*:
   1.1. *Target/Bycatch:* Primarily a target catch
   1.2. *Value:* This is a moderately high value fish. Current MFish port price is $3.70 per kilo.
   1.3. *Live return/legal discard:* No discarding allowed.
   1.4. *Commercial/Shared:* Commercial.
   1.5. *Biological productivity and risk*: Orange roughy are very slow-growing, long-lived fish. On the basis of otolith ring counts and radiometric isotope studies, orange roughy may live up to 120–130 years. Natural mortality is very low relative to most finfish. Fecundity is also relatively low. Orange roughy also tend to form aggregations for spawning and for feeding.
   1.6. *Stock status:* The ORH3B stock is believed to have two main stocks **(**the Chatham Rise and Southern Fishery) but assessments are done for substocks in the Northwest, Northeast and South Chatham rise as well as for separate areas of the Southern fishery. For the Northeast Chatham Rise, for all alternative assessment runs, biomass is estimated to have been slowly decreasing in recent years. The estimated current status of the stock is strongly dependent on how the CPUE data are treated. The stock is either above or below Bmsy depending on assumptions relating to CPUE. The Northwest Chatham Rise stock is estimated to be above B_{MSY}. Further, all estimated reference yields (MCY, CAY, MAY and CSP) are greater than recent catches, which have averaged 4100 t over the last four years. Current catch levels are predicted to result in the stock biomass increasing over the next ten years. The status of the South of this stock is uncertain because of the limited information available. The Puysegur fishery has been voluntarily closed since 1997–98 and zero catch should allow the stock to move towards B_{MSY}.

   1.7. *Nature of quota ownership and control:* Quota ownership is heavily concentrated with two quota owners each owning 35% of the total and only 10 quota owners in total. The 36% ownership by Pupuri Taonga Limited (Sealord) may underestimate concentration of control since TOKM owns a further 7.5%.



2. *Historical and future use of deemed values*
   2.1. *Historical use:* The TACC for this stock has been exceeded only once since 1986 and not since 1989. Deemed values paid have been minimal.
   2.2. Expected or potential future use: There is little reason to expect significant use of deemed values to cover catch in future as long as they remove any benefit from targeting the stock. The stock is taken intentionally and is not a significant bycatch of other fisheries that would.
3. *Deemed Value Policy*
   3.1. Present policy: Deemed value is $4 which is higher than the MFish port price of $3.70

3.2. *Relevant information of setting deemed value:* Expected port price, ACE price, prior year's catch, quota ownership concentration. Published ACE price average $2.19 in 2003 with low of $0.42 and a high of $3.31. Given the 35% ownership concentration, the effective deemed value, if deemed values were distributed to quota holders, would be $2.60. This is significantly above average ACE price, but may not be above the marginal ACE price. Should exceed the 90th percentile ACE price.

3.3. *Proposed general basis for setting deemed value (not overcatch situation):* Enough above ACE price to create effective ACE price, after rebate, in excess of actual ACE price. Given the quota ownership concentration, deemed value should be set around 35% above the 90th percentile ACE price from the prior year.

3.4. *General response to overcatch:*

3.4.1. *Temporary overcatch:* As this is a target species unintentional overcatch should not occur even on a temporary basis unless deemed values are insufficient to deter deliberate overcatch. Therefore, deemed values should probably be raised in response to overcatch.

3.4.2. *Chronic overcatch:* Chronic overcatch should not be allowed to occur given the response for temporary overcatch above.

3.5. *General response to undercatch:* Deemed value should be set around 35% above the 90th percentile ACE price from the prior year.

3.6. *Appropriate Response to current situation:* Catch for this stock has not exceeded the TACC since 1989 and was only 89% of the TACC in 2003-04. Therefore deemed value should be set at 35% above the 90th percentile ACE price.

4. *Risks and Special Concerns*

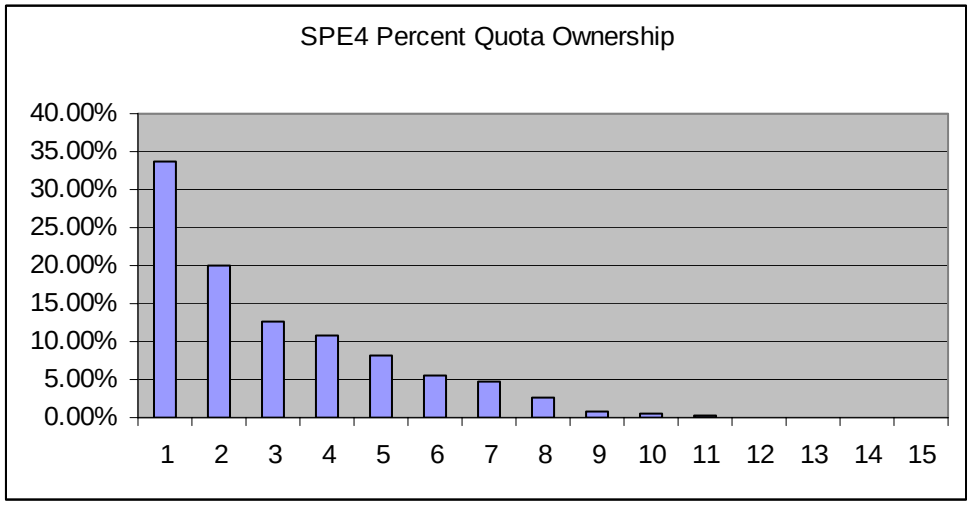
4.1. *Biological-ecological risk:* The biological characteristics of orange roughy could make the stock more vulnerable to overfishing and collapse than many other finfish species.

4.2. *Deliberate overfishing*: The slow growth and low productivity of this stock could create a situation where economically optimal exploitation would involve deliberate depletion or pulse fishing. The concentrated ownership of the stock and the fact that it is a target stock could enable quota holders, through the return of deemed values in proportion to quota holdings, to conspire to deliberately exceed the TACC. However, this will easily observable and could be quickly stopped through use of overfishing thresholds. Concentrated ownership may also require increasing the deemed value to at least 35% above the ACE price to be an effective deterrent at the individual level.

4.3. *Impacts on other stakeholders:* No impact on recreational or customary sectors.

Case Study: SPE4

1. *Characteristics*:
   1.1. *Target/Bycatch:* The majority of the SPE 4 catch is taken as a bycatch of the hoki target fishery (about 59%), with the ling and hake fisheries accounting for around 25% and 10% of the total SPE 4 catch, respectively. In 1994–95, a significant proportion of the sea perch catch was taken by the scampi fishery (approximately 25%).
   1.2. *Value:* This is a low value species. The MFish port price is $0.75. However, the stock could have a significant shadow value if it is constraining hoki, hake or ling fisheries.
   1.3. *Live return/legal discard:* No discarding allowed.
   1.4. *Commercial/Shared:* Commercial fishery.
   1.5. *Biological productivity and risk*: This is a fairly long lived and slow growing species maturing at 5-7 years and reaching ages as high as 40 years.
   1.6. Stock status: No estimates of current status available. For all other Fishstocks, it is not known if recent catch levels are sustainable or at levels that will allow the stock to move towards a size that will support the MSY.
   1.7. Nature of quota ownership and control: Quota ownership is concentrated. The Chatham Islands Management Ltd. owns nearly 34%, TOKM holds 20% and Pupuri Taonga Limited owns around 12.5%. However, Chatham Islands Ltd quota is made available to local fishers and not managed as a single entity. TOKM quota ownership will become dispersed. Therefore, overall concentration from a practical standpoint (in terms of how return of deemed value revenue effects incentives) should be only moderate and should not require a significant accommodating response in setting deemed values.



2. *Historical and future use of deemed values*
   2.1. Historical use: Catch has exceeded the TACC by 50-216% every year since introduction to the QMS. Catches have been increasing steadily and substantially in the last few years. In 2002-03, $93,000 was paid in deemed value as compared to only $31,000 in 2001-02. Catch in 2003-04 dropped significantly despite no increase in deemed value. This could have been partly due to a drop in hoki catches.
   2.2. Expected or potential future use: catch of SPE4 is likely to decline further due to the drop in the hoki TACC. However, there appears to be good reason to consider at TACC increase given that the fishery has sustained catches well over the TACC for several years without an apparent decrease in the stock (and some indication of an increase)
3. *Deemed Value Policy*
   3.1. Present policy: Deemed values, at $0.08 are set low relative to port price and no differential is applied. This deemed value appears to have been purposely set, under the low knowledge bycatch category, to avoid undue constraint on target fisheries. It would, however, be more

appropriate to consider a TACC increase rather than simply allow overfishing to occur with a permissive deemed value.

3.2. Relevant information of setting deemed value: Overcatch, Port price, ACE price, shadow value as bycatch in the hoki, ling and hake fisheries. The MFish port price is $0.75. Ace price ranged from $0.04- to $0.10 with an average price of $0.064. This ACE price was apparently constrained by the deemed value. The deemed value was insufficient deterrent to constrain catch to the TACC.

3.3. Proposed general basis for setting deemed value(not overcatch situation): set deemed value at 10-20% above the 90th percentile ACE price.

3.4. General response to overcatch:

3.4.1. Temporary overcatch: Raise deemed value to slightly below the landed value of catch taken as bycatch (this may differ from port price if port price reflects targeted catches that are handled differently).

3.4.2. Chronic overcatch:

3.4.2.1. Review SPE4 TACC. If decision is not to raise it, go to 3.4.2.2

3.4.2.2. Review Hoki TACC and industry agreement on the split of hoki catch between areas. If decision is not to attempt to lower hoki catch in the SPE4 area, go to 3.4.2.3

3.4.2.3. Review Deemed Value. In cases where there has been persistent overcatch it may be more relevant to consider what the current deemed value is relative to port price as opposed to what the ACE price is since ACE price will presumably be driven by deemed value. In such a case, with a bycatch stock, you would probably want to set deemed value at around the port price to take away any incentives to target the stock without ACE. If overcatch is thought to be threatening viability or if a significant proportion of quota owners (the proportion should probably be higher than the 5% now required under 14b) don't want to see the TACC raised, it may be necessary to set deemed value above port price, but concern should be given to whether this will result in unreported discards. There should be a compliance response if deemed value is well above port price and a signal that compliance will be closely monitored.

3.4.2.4. If deemed values appear ineffective at limiting catch, it may be necessary to use other management measures. As a last resort, overfishing thresholds could be imposed.

3.5. General response to undercatch: set deemed value at 10-20% above the 90th percentile ACE price.

3.6. Appropriate Response to current situation: Consider raising TACC. If TACC is not raised it may be appropriate to raise deemed value somewhat. However, there is good reason to expect catches to fall this year, so little or no increase in deemed value would probably be necessary.

4. Risks and Special Concerns

4.1. Biological-ecological risk: No particular characteristics that create unusual risk.

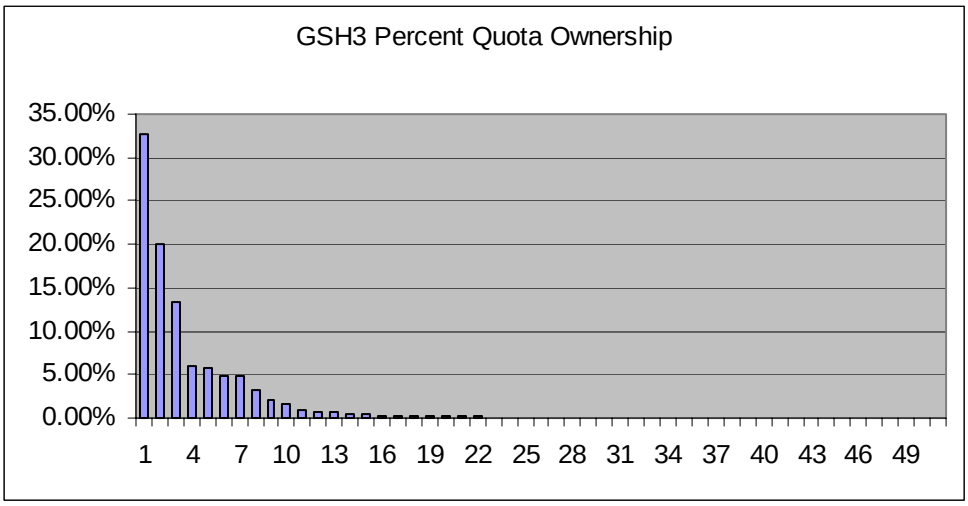
4.4. Deliberate overfishing: Because this fishery is primarily a bycatch fishery, it is possible that the optimal TACC, from the perspective of at least some quota owners, would allow the stock to decline below the level that would produce MSY. There has clearly been deliberate catch in excess of available ACE for this stock in the past (despite ramped deemed values not returned to quota holders). This has apparently been due to the fact that SPE4 ACE availability constrained the highest value use of Hoki ACE to the extent that it was worthwhile paying deemed values. Nevertheless, there is little reason to believe that quota holders would conspire to utilize deemed values to create an unofficial TACC. The benefits from overcatch of ACE are related primarily to a lack of balance with hoki quota for some companies, but the imbalance and thus the benefits of overcatch vary greatly across players. There is a reasonably large number companies responsible for use of deemed values. Some, including the company with the lion share of unbalance catch, own no quota and would thus get no benefit from rebated deemed value. It would require a very complex agreement to equalize net benefits of overcatch across all parties. Presumably they would instead seek a

TACC increase official. Since this is not a shared fishery and is primarily a bycatch fishery a TACC increase should be granted unless viability is at risk. The focus of deemed value policy should remain on ensuring that the deemed value is still an effective deterrent at the individual level.

4.2. *Impacts on other stakeholders:* No impact on recreational or customary sectors.

Case Study: GSH3

1. *Characteristics*:
   1.1. *Target/Bycatch:* Both ghost shark species are taken almost exclusively as a bycatch of other target trawl fisheries. In the 1990s, about 43% of ghost sharks were landed as a bycatch of the hoki fishery, with fisheries for silver warehou, arrow squid and barracouta combining to land a further 36%. This applies to all ghost shark catch. Information is not given on the nature of bycatch for GSH3 specifically.
   1.2. *Value:* This is a low value species. The MFish port price for 2004 was $0.46 per kilo up from $0.42 in 2003. The ACE price averaged around $0.04 and ranged from $0.025 to $0.053 per kilo. The ACE price would not have been expected to exceed $0.05 given that was the annual deemed value and there was not differential deemed value applied.
   1.3. *Live return/legal discard:* No discarding allowed.
   1.4. *Commercial/Shared:* Commercial
   1.5. *Biological productivity and risk*: Little is known about ghost shark biology or population dynamics. However, as for most other elasmobranchs, ghost shark fecundity is likely to be low possibly increasing the risk of depletion.
   1.6. Stock status: No estimates of current and reference biomass are available for dark ghost shark. While inshore trawl surveys have generally exhibited a trend of increasing dark ghost shark biomass in recent years, the more comprehensive middle depths surveys produced wide fluctuations in estimated biomass. Reported landings from this fishery have been increasing in recent years, probably owing to both an increased level of catch and to more accurate reporting. It is not known if recent catch levels or current TACCs are sustainable in the long term or whether they will allow the stocks to move towards a size that will support the maximum sustainable yield.
   1.7. *Nature of quota ownership and control:* There are over 50 quota owners but only 10 with 1% or more of the total. One company, Sanford, owns 33% of the total. The next largest quota owner is TOKM with 20% of the total; however this quota will presumably become dispersed. KPF Investments, LTD is the only other



2. *Historical and future use of deemed values*
   - 2.1. *Historical use:* The TACC for this stock was exceeded for the first time in 2002-03 (by 15%) but ACE was exceeded by only 11%, presumably due to carry forwards. Catch was 28% below available ACE in 2003-04.
   - 2.2. *Expected or potential future use:* Catches have been fluctuating but dropped dramatically in 2003-04 and are likely to remain low due to the drop in the hoki TACC. However, catches and use of deemed value if the TACC in not increased could be expected to increase again if the GSH stock increases and or the hoki TACC increase.
3. *Deemed Value Policy*
   - 3.1. *Present policy:* Deemed values, at $0.05 are set low relative to port price and no differential is applied. This deemed value appears to have been purposely set, under the low knowledge bycatch category, to avoid undue constraint on target fisheries. It would, however, be more appropriate to consider a TACC increase rather than simply allow overfishing to occur with a permissive deemed value.
   - 4.3. *Relevant information of setting deemed value:* Overcatch, Port price, ACE price, shadow value as bycatch in hoki and inshore finfish fisheries. The MFish port price is $0.46. Ace price ranged from $0.025- to $0.053 with an average price of $0.04. This ACE price may have been constrained by the deemed value, but, since the TACC was not exceeded this is not necessarily the case.
   - 4.4. *Proposed general basis for setting deemed value:* set deemed value at 10-20% above the 90th percentile ACE price.
   - 4.5. *General response to overcatch:*
     - 4.5.1. *Temporary overcatch:* Raise deemed value to slightly below the landed value of catch taken as bycatch (this may differ from port price if port price reflects targeted catches that are handled differently).
     - 4.5.2. *Chronic overcatch:*
       - 4.5.2.1. Review GSH3 TACC. If decision is not to raise it, go to 3.4.2.2
       - 4.5.2.2. Review Hoki TACC and industry agreement on the split of hoki catch between areas and potentially TACCs of other stock with high GSH3 bycatch . If decision is not to attempt to lower hoki or other target TACCs in the GSH3 area, go to 3.4.2.3
       - *4.5.2.3.* Review Deemed Value. In cases where there has been persistent overcatch it may be more relevant to consider what the current deemed value is relative to port price as opposed to what the ACE price is since ACE price will presumably be driven by deemed value. In such a case, with a bycatch stock, you would probably want to set deemed value at around the port price to take away any incentives to target the stock without ACE. If overcatch is thought to be threatening viability or if a significant proportion of quota owners (the proportion should probably be higher than the 5% now required under 14b) don't want to see the TACC raised, it may be necessary to set deemed value above port price, but concern should be given to whether this will result in unreported discards. There should be a compliance response if deemed value is well above port price and a signal that compliance will be closely monitored.
       - 4.5.2.4. If deemed values appear ineffective at limiting catch, it may be necessary to use other management measures. As a last resort, overfishing thresholds could be imposed.
   - 4.6. *General response to undercatch:* set deemed value at 10-20% above the 90th percentile ACE price.
   - 4.7. *Appropriate Response to current situation:* Leave deemed value unchanged
5. *Risks and Special Concerns*
   - 5.1. *Biological-ecological risk:* The low fecundity of this type of species creates some concerns for this stock. If there is evidence that the stock is in decline a stricter and risk averse deemed value policy might be called for than for some other bycatch species.

4.5. *Deliberate overfishing*: Because this fishery is primarily a bycatch fishery, it is possible that the optimal TACC, from the perspective of at least some quota owners, would allow the stock to decline below the level that would produce MSY. Nevertheless, there is little reason to believe that quota holders would conspire to utilize deemed values to create an unofficial TACC. The benefits from overcatch of ACE are related primarily to a lack of balance with quota for target species, but the imbalance and thus the benefits of overcatch is likely to vary greatly across players. The one large quota owner could potentially benefit from a strict deemed value policy as they might, through their share of deemed value revenues, be able to usurp some of the value from target stock ITQ held by others. It would require a very complex agreement to equalize net benefits of overcatch across all parties. Presumably they would instead seek a TACC increase official. Since this is not a shared fishery and is primarily a bycatch fishery a TACC increase should be granted unless viability is at risk. The focus of deemed value policy should remain on ensuring that the deemed value is still an effective deterrent at the individual level.

5.2. *Impacts on other stakeholders:* No impact on recreational or customary sectors.

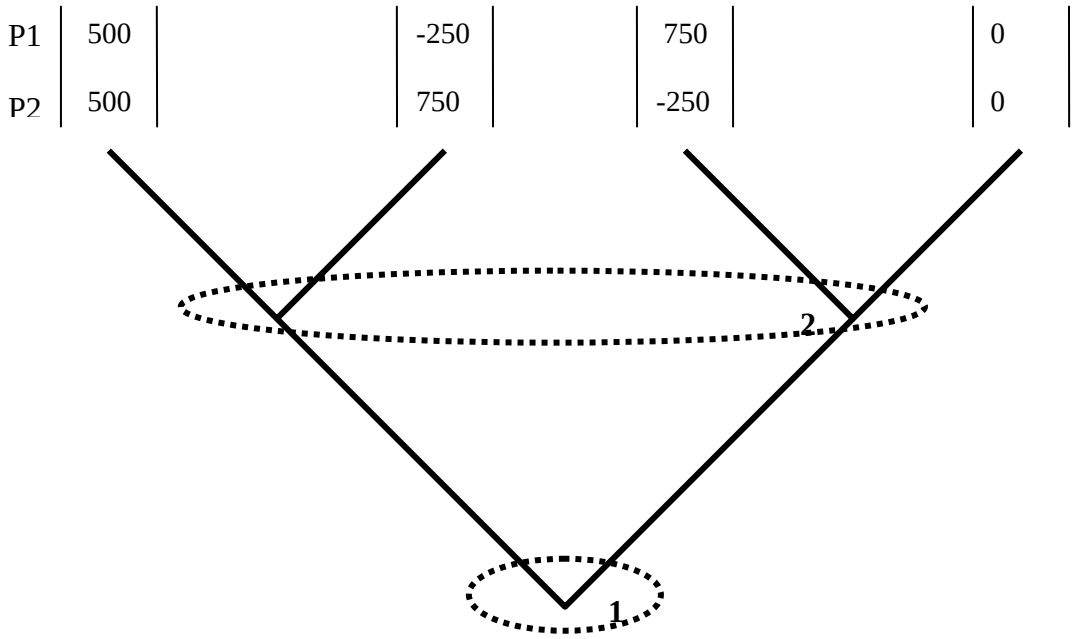
Appendix C: Game theoretic analysis of effect of return of deemed value revenues incentives

If deemed values are less than the value generated by catch not balanced with ACE, then individuals may have an incentive to catch and land fish in excess of their ACE holdings regardless of whether deemed values are rebated in proportion to quota ownership. The same is clearly true if the net deemed value (after the rebate) paid by the individual is less than the benefit of the uncovered catch.

But what if deemed values are set high enough so that the net deemed value after any rebate exceeds the net value of unbalanced catch? Will there still be incentives for individuals to use deliberately used deemed values to balance catches in excess of ACE holdings. We use a simple game theoretic approach to illustrate that return of deemed value revenues to quota holders is not likely to result in deliberate overfishing in this case. As the analysis shows, even when deliberate overfishing in proportion to quota holdings might provide net benefits for all fishers, the individual incentives still dissuade individuals from deciding to catch in excess of ACE. The decisions of other players are irrelevant since, no matter what the other players do, the individual is better off not overfishing. Only if all the players agree to exceed their ACE and each can be assured that the others will keep the agreement, will it pay of an individual to utilize deemed value as a means to catch fish in excess of ACE.

We begin by considering the simplest case with only two quota owners each owning half of the total quota. We then show that the conclusions are unchanged when there are three quota owners with equal proportions of the total quota. Finally we consider the effect of heterogeneous quota ownership and show that the same conclusion applies.

Two Player Overfishing Game (Prisoner's Dilemma)



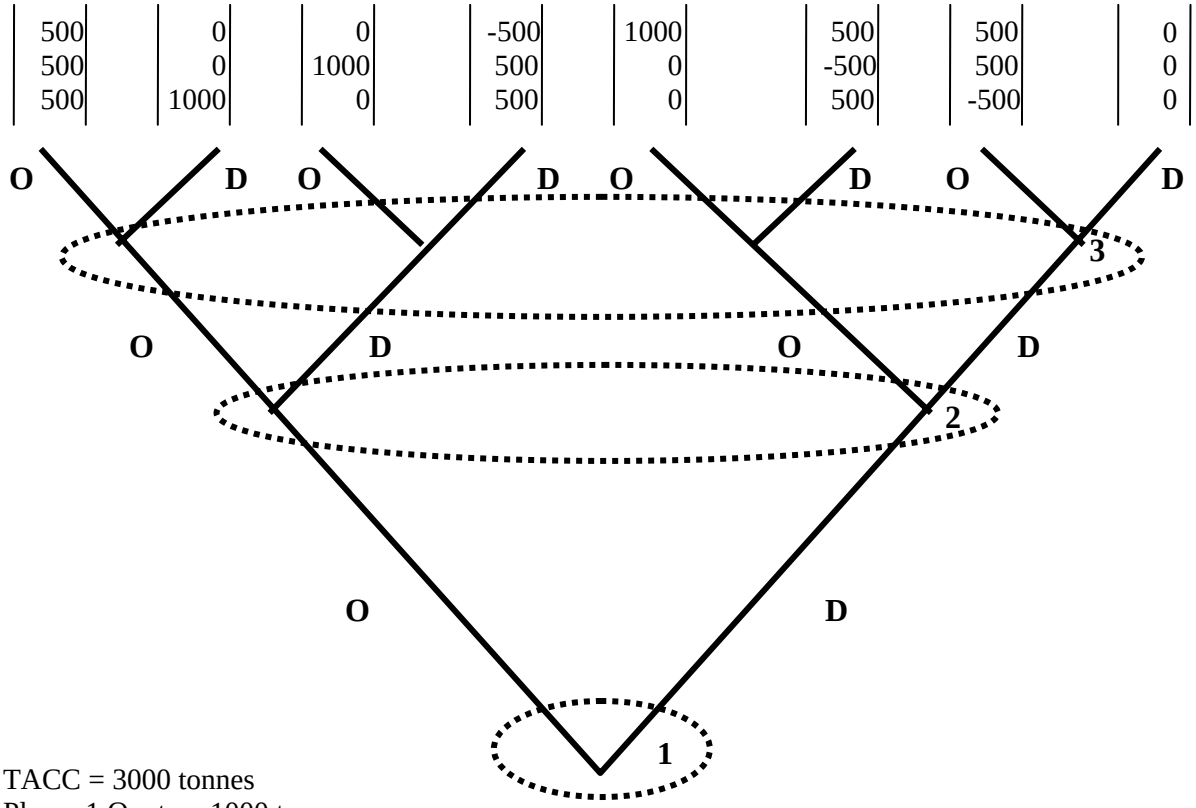
TACC = 2000 tonnes
Player 1 Quota = 1000 tonnes
Player 2 Quota = 1000 tonnes
Deemed Value = $3.00/kilo
Net Value of Catch = $1.00/kilo
Strategies

a. D: don't overfish
b. O: overfish quota by 50%

The two players each have 50% of the overall quota and consequently will receive back 50% of any deemed values they themselves pay and 50% of any deemed values paid by the other player. If player 1 overfishes and player 2 overfishes as well, each of them make a profit of $500K. The each get a net value from the catch of $500K, they each pay $1500K in deemed values, and they each receive back $1500K in rebated deemed values ($750K of their own and $750K of what the other player paid). If player 1 overfishes, but player 2 does not, player 1 loses $250k while player 2 makes $750K. Player 1 gets a net value of $500k from the catch, pays $1500 in deemed value and gets a rebate of $750K. Player 2 simply gets a rebate of $750K, his share of deemed values paid by Player 1. If player 1 does not overfish, but player 2 does, the situation is reversed and player 1 makes $750K while player 2 loses $750K. Finally, if both players do not overfish, neither make any additional profit over and above that associated with use of their ACE.

In this game, each player has a dominant strategy in the sense that the player is always better off choosing not to overfish no matter what the other player chooses to do. This is the equilibrium strategy.

Three Player Overfishing Game (Prisoner's Dilemma)



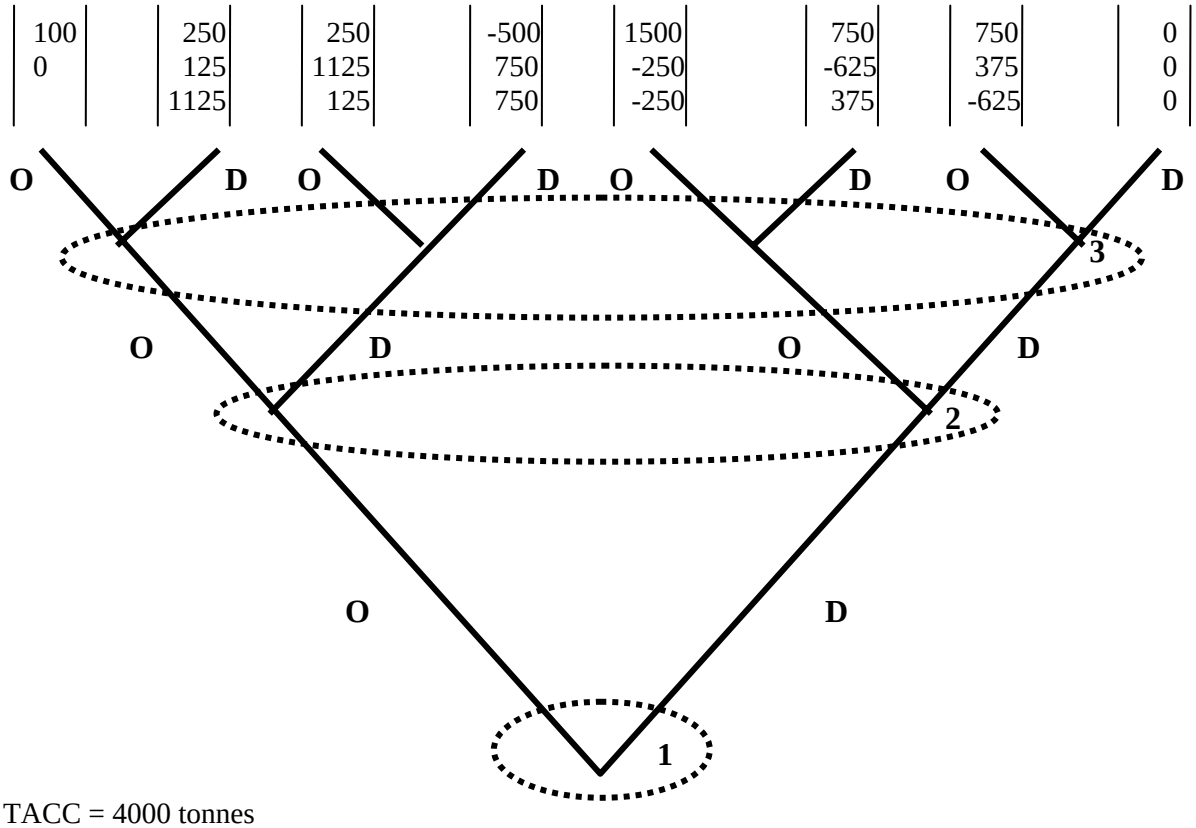
TACC = 3000 tonnes
Player 1 Quota = 1000 tonnes
Player 2 Quota = 1000 tonnes
Player 3 Quota = 1000 tonnes
Deemed Value = $3.00/kilo
Net Value of Catch = $1.00/kilo
Strategies

c. D: don't overfish
d. O: overfish quota by 50%

The three players each have one-third of the overall quota and consequently will receive back one-third of any deemed values they themselves pay and one-third of any deemed values paid by the other players. If player 1 overfishes and players 2 and 3 overfish as well, each of them make a profit of $500K. The each get a net value from the catch of $500K, they each pay $1500K in deemed values, and they each receive back $1500K in rebated deemed values ($500K of their own and $500K of what each other player paid). If players 1 and 2 overfish, but player 3 does not, players 1 and 2 neither gain nor lose, but player 3 makes $1000K. Players 1 and 2 gets a net value of $500k from their catch, pay $1500 in deemed value and gets a rebate of $1000K (one-third each of what he and player 2 paid in deemed value). Player 3 simply gets a rebate of $1000K, his share of deemed values paid by players 1 and 2. If player 1 overfishes, but players 2 and 3 do not, then player 1 loses $500K while players 2 and 3 each make $500K. Player 1 gets a net value from the catch of $500K, pays $1500K in deemed values, and gets $500K rebated. Players 2 and 3 simply take the rebate of $500K from the deemed values paid by player 1. The rest of the pay-offs follow since the game is symmetric.

Again, although all three players can gain if they overfish, the dominant strategy for all players is to not overfish since each is better off not overfishing regardless of what the other two players do.

Three Player Overfishing Game (Prisoner's Dilemma) with Heterogeneous Ownership



TACC = 4000 tonnes
Player 1 Quota = 2000 tonnes
Player 2 Quota = 1000 tonnes
Player 3 Quota = 1000 tonnes
Deemed Value = $3.00/kilo
Net Value of Catch = $1.00/kilo
Strategies

e. D: don't overfish
f. O: overfish quota by 50%

The payoff structure is more complex with heterogeneous quota ownership, but, as long as the deemed value is greater than the combination of the individual's direct benefit from overfishing and the share of their own deemed values they get rebated, the dominant strategy for all players is not to overfish.

Players 1 has 50% of the overall quota and consequently will receive back 50% of any deemed values they themselves pay and 50% of any deemed values paid by the other players. However, players 2 and 3 will only receive back 25% of any deemed values paid by themselves or other players. If player 1 overfishes and players 2 and 3 overfish as well, player 1 makes 1000 and players 2 and 3 each make a profit of $500K. Each get the net value from fishing ($1 x the quantity of overfishing) and they each receive back a rebate of the deemed values they paid. For example, player 2 pays $1500K in deemed values and receives back 25% of that plus 25% of what players 1 and 3 paid for a total of $1500K.

If players 1 and 2 overfish, but player 3 does not, players 1 and 2 gain $250K and $125K respectively while player 3 gains $1125K. Players 1 gets a net value of $1000k from their catch, pays $3000 in deemed value and gets a rebate of $2250K (one-third each of what he and player 2 paid in deemed value). Player 3 simply gets a rebate of $1125K, his share of deemed values paid by players 1 and 2.

If players 1 and 3 overfish, but player 2 does not, the payoff of player 1 is still $250K but the payoffs for players 2 and 3 are reversed.

If player 1 overfishes, but players 2 and 3 do not, then player 1 loses $500K. Player 1 gets a net value from the catch of $1000K, pays $3000K in deemed values, and gets $1500K rebated. while players 2 and 3 each make $750K, their 25% shares of the $3000 in deemed values paid by player 1.

The right hand branches have player 1 not overfishing. If Player 1 does not overfish but players 2 and 3 both do, then player 1 receives 50% of the deemed values paid by both players 2 and 3 for a total of $1500K. Players 2 and 3 each lose $250K. The each make $500K off their overcatch, but pay $1500K in deemed values and get only $750K back.

If players 1 and 3 do not overfish, but player 2 does, players 1 and 3 each get back their respective shares of the deemed values paid by player 1 for profits of $750K and $375K respectively. Player 2 makes $500K from the overcatch but pays $1500K in deemed values and only gets a $375K rebate for a loss of $625. Payoff's for players 2 and 3 are reversed if players 1 and 2 do not overfish, player but player 3 does.

Finally, if no players overfish, the payoffs for all players are zero.

As before, the dominant strategy for all players is still to not overfish. For example player 1 gets a higher payoff by not overfishing relative to overfishing whether both other players overfish ($1500K vs. $1000K), one other player overfishes ($750K vs. $250K) or both neither other player overfishes ($0 vs. -$500). The payoffs for player 2 are also higher for not overfishing if both other players overfish ($1125K vs. $500K), if player 1 does not overfish but player 3 does ($375K vs. -$250), or if neither other player overfishes ($0 vs. -$625K). The same logic follows for player 3.

Conclusions

In each of the cases above, there are positive payoffs for all players if all players overfish. However, the individual's highest payoff, regardless of what the other players choose to do, is always not to overfish. This is the equilibrium strategy that we would expect to see in the absences of collusive behavior and results in no deliberate overfishing and thus zero benefits from overfishing. While the result of collusion can bring benefits to all parties in all three games, the incentive for players to defect from that strategy exists in each case. One can only guess at whether such a collusive agreement would hold in the absence of an enforceable contract.

It is important to keep in mind that the quota holders future benefits from decisions by them or others to overfish are likely to be reduced as a result of lower TACCs and less ACE in the future than might have occurred in the absence of the overfishing. This should provide an additional incentive not overfish individually or to collude in overfishing.

The most problematic areas for deemed values are with species primarily taken as bycatch. In most if not all of these cases the quota is not distributed in proportion to the ACE that different companies need to cover their bycatch. This is typically because the distribution of quota for the bycatch species is proportionate to the distribution of the quota for the target species. If the primary benefit of overcatch is derived from the ability to utilize the target quota without constraint, then the benefits of exceeding one's ACE for the bycatch species can be quite different across the players. Those with a greater share of bycatch quota relative to target quota may derive little if any benefit for exceeding their ACE while those with smaller holdings of bycatch quota in proportion to target quota may derive large benefits from exceeding their ACE. In this case a collusive agreement to deliberately exceed the TACC are would require a complex system of side payments to distribute the benefits. This should reduce the likelihood of collusion.