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PERMANENT WORKING GROUP ON FLEET CAPACITY

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CONSULTANT'S REPORT[1]

This report comprises two parts:

- first, a summarized description of the steps to be eventually taken for the implementation of the proposed scheme for the allocation of fishing days with a transferable day credit program;
- second, a more detailed background analysis of the scheme with the necessary elements for its consideration and discussion

A. Proposal for the allocation of fishing days with a transferable day credit program:

This proposed transferable day credit program as a mean to address and compensate the problems created by excess capacity of the purse seine fleet in the Antigua Convention area must be understood as the first step of broader fleet capacity management program. It would set the stage for capacity reduction, not only through means such as buybacks, which have been thoroughly explored, but also by allowing individual companies to retire vessels and reassign days[2] among the remaining vessels.

As previously considered, it is suggested that a three-year pilot program be adopted, consistent with the usual IATTC conservation and management measures cycle, which will allow to assess the way the scheme is implemented and its effects on the operation of the fisheries and on the resulting fishing effort.

The first step in the implementation of the pilot program would be to calculate each vessel's Proportional Allowable Effort Share (PAES), which is the proportion or share of the total allowable effort (TAE) to be allocated to each individual vessel. The TAE is the total nominal days during one management year. The allocation of the proportional share to each individual vessel is to be made by the respective flag State.

In general terms, the PAES can be calculated as either a vessel's historical days or a hybrid of a vessel's historical days and days/m3 of well capacity for purse seine vessels that are active on the Regional Vessel Register.

There are basically four options or formulas to calculate the PAES:

Option 1: *Average 3 Years*: The historical days formula Average 3 Years is the average of a vessel's days over 2016-2018.

Option 2: *Best X of Y*: The historical days formula Best X of Y is each vessel's days during 2014-2018 and

[1] The scientific results and conclusions, as well as any views or opinions expressed herein, are those of the author(s) and do not necessarily reflect the views of NOAA or the Department of Commerce.

[2] A day is any calendar day, or part of a calendar day, in a Management Year during with a purse seine vessel is in the waters under the jurisdiction of the IATTC outside of a port.

chosen as:

a) Out of the most recent 5-year effort history, each vessel is allocated an average of its best 3 years of effort out of the most recent 5 years the vessel has been active on the regional vessel register.
b) The average 3 out of the most recent 4 years of effort if a vessel has only been active on the regional vessel register 4 out of the past 5 years.
c) The average 2 out of the most recent 3 years of effort if a vessel has only been active on the regional vessel register 3 out of the past 5 years.
d) The average 1 out of the most recent 2 years of effort if a vessel has only been active on the regional vessel register 2 out of the past 5 years.
e) A vessel active on the regional vessel register for 1 out of the past 5 years receives its effort for that one year.

Option 3: *Days/m^3 of Capacity:* Days are directly proportional to a vessels m^3 of capacity

Option 4: *Hybrid* of Best X of Y and Days/m^3 Capacity lets vessels choose whichever is larger, Best X of Y days or days directly proportional to vessel m^3 of capacity.

The Commission should discuss these options and select the PAES formula that should be utilized. When so doing, the Commission should note that the empirical analysis for the allocated days from the four alternative PAES formula shows that Best X of Y gives the greatest economic efficiency through the increase in daily vessel operating profit following introduction of the transferable day program. The analysis further shows that equity of daily vessel operating profit among individual vessels and allocated PAES by Flag State are very similar among the four PAES alternative.

For that reason, this report recommends that either Option 2 or Option 4 be preferred:

- Option 2, the "*Best X of Y*" formula since it would ensure a scheme for greatest economic efficiency;
- Option 4, the "*Hybrid*" formula as a compromise between PAES allocation based upon historical days and wells capacity in cubic meters.

B. Background analysis:

The Transferable Day Credit Scheme

The proposed transferable day credit scheme is the first step in the proposed Fleet Capacity Program for purse seine vessels.[3] [4] The transferable day credit scheme allows vessels to adjust their operations and increase daily vessel profitability. The scheme substitutes an overall Total Allowable Effort for the time-

[3] The Fleet Capacity Plan draws upon 1998 IATTC C-98-11 Resolution on Fleet Capacity: 1–2, 2009 IATTC Resolution C-00-06, and 2002 IATTC Resolution C-02-03 on Fleet Capacity, 2005 Lanzarote Plan of Action (*Plan for Regional Management of Fishing Capacity*), the 2012 Mexico City IATTC workshop on vessels buybacks, the 2014 Cartagena IATTC Technical Experts Workshop on the capacity of the tuna-fishing fleet in the EPO, the 2016 La Jolla 17th meeting of the Permanent Working Group (WG) on Fleet Capacity, the 2018 European Union-sponsored consultancy on the Contribution to the Development of a Plan of Action for the Management of the Fleet Capacity in the Inter-American Tropical Tuna Commission made in response to the IATTC's agreement to develop a concrete and pragmatic plan of action for capacity management, based among others on the elements that it has identified and adopted during its annual meeting in 2016 ("*Elements for implementing a fleet capacity management plan in the IATTC"*), the 21st Meeting of the Permanent Working Group on Fleet Capacity in July 2019, the report of the consultant on a fleet capacity management plan and associated measures at the IATTC's 94th Meeting in July 2019.

[4] Effort rather than catch is recommended due to the very practicable issues of monitoring, surveillance, enforcement, and compliance and as an extension of the current effort-based approach.

area closure.[5] [6] Otherwise, the fishery faces a growing time-area closure due to overcapacity. Any biological objectives would be retained (e.g. "El Corralito"). The scheme could also be differentiated by area. The transferable day credit scheme helps restructure incentives from "the race to fish" to more closely align with cooperation and IATTC objectives.

The transferable day credit scheme provides flexibility throughout the year when a vessel can fish and land catch, helps ensure a steady supply of fish to processors, and increases daily vessel operating profit through either more efficient use of days for each individual vessel or by allowing multi-vessel companies to optimally reallocate days to their vessels (some vessels would fish more and others less).

After the transferable day credit scheme has set the stage for capacity reduction, capacity reduction then follows through an IATTC-wide or national vessel buyback program and/or by allowing individual companies to retire vessels and reassign days among their remaining vessels. A previous economic analysis by the consulting company Northern Economics showed that vessel buybacks can pay for themselves and increase profitability. A previous analysis showed that the transferable day credit scheme can increase vessel profitability.

The transferable day credit scheme is suggested as a three-year pilot program, consistent with the IATTC Resolution cycle, without any permanent vessel exit due to the scheme, and with restrictions on transfers of unused days between vessels. The intent of the pilot and limits on the program are to reduce risk and uncertainty for vessels and to allow learning about the scheme. After three years, the scheme can be evaluated and revised or the fleet can revert to some facsimile of the current situation. The eligible vessels are those active on the Regional Vessel Register.

The transferable day credit scheme requires an allocation of days to individual vessels (through their Flag State Contracting Party to the IATTC).

The following definitions, which were previously presented (and are drawn from the PNA Vessel Day Scheme), are:

- Day: Any calendar day, or part of a calendar day, in a Management Year during with a purse seine vessel is in the waters under the jurisdiction of the IATTC outside of a port.
- Total Allowable Effort (TAE): Total nominal days for a Management Year.
- Proportional Allowable Effort Share (PAES): CPC's proportion (share) of Total Allowable Effort
- Allowable Effort (AE): Allowed days in Management Year based upon PAES and TAE
- Management Year:
- Credit: Unused portion of a vessel's Allowable Effort during a Management Year.
- Capacity: m^3 of purse seine vessel well capacity active on the IATTC Regional Vessel Register.

Purpose of the Analysis

The purpose of this analysis is to develop alternative allocation formulae, evaluate each formula in terms of economic efficiency (profitability) and equity and fairness, and provide a recommendation among the alternatives.

[5] Amendment to Resolution C-17-01, approved by the IATTC at its 2017 92nd Meeting in Mexico City in which all purse-seine vessels must currently stop fishing in the Convention Area for a period of 72 days in each year and that the fishery for yellowfin, bigeye, and skipjack tuna by purse-seine vessels within the area of 96º and 110ºW and between 4°N and 3°S, known as the "*corralito*" shall be closed from 00:00 hours on 9 October to 24:00 hours on 8 November of each year, and that CPCs shall ensure that purse-seine vessels flying their flag have no more than the following number of FADs active at any one time, as defined in Resolution C-19-01, Amendment to Resolution C-18-05 on the Collection and Analyses of Data on Fish-Aggregating Devices, approved by the IATTC at its 2019 94th Meeting in Spain: Class 6 (1,200 m^3 and greater) 315 FADs, Class 6 (< 1,200 m^3) 210 FADs, Class 4-5 85 FADs Class 1-3 50 FADs

[6] Because the time-area closure applies equally to all vessels, this implicit allocation formulae is equal division, an equity principle.

The analysis evaluated the gains in economic efficiency and the impact upon equity due to the transferable days credit scheme for four different methods of allocating Proportional Allowable Effort Shares (PAES) to vessels active on the Regional Vessel Register. Gains in economic efficiency were measured by increases in daily vessel operating profit from before and after the scheme for the four different PAES formulae. Equity impact was evaluated by well-established equity metrics from economics and information theory.

Economic efficiency per day rather than per year was selected because the methods of defining the allocation formulae gave data sets with different number of vessels and total days, i.e. different sample sizes, since the same number of vessels was not the same in the years 2014-2018 and 2016-2018 used to calculate the different formula. A daily economic efficiency measure gives a more consistent and standardized efficiency metric.[7]

Two PAES allocation formulae were based upon Contracting Parties to the Conventions' vessels' historical days, Best X of Y and Average 3 Days (defined below). Two more PAES allocation formulae, Days per m^3 of Capacity and Hybrid (defined below), are calculated from the same data as Best X of Y. The Hybrid fourth formula forms a compromise between historical days and capacity for PAES.

Using updated data, the method of analysis is the same as used in the previous analysis of gains in economic efficiency reported in "Plan of Action for the Management of Fleet Capacity", April 2019 in La Jolla CA, USA and July 2019 in Bilbao, Spain.

Equity and Fairness

A request to consider equity was incorporated into the analysis. The perceived equity of an allocation depends upon the particular nature of the situation, such as the nature of the exogenous rights, the "good" to be allocated (here days), the salient characteristics of the claimants (here Flag States, vessels), etc.

Principles of equity when applied to an allocation turn out to confer numerous advantages: they provide a consistent, non-arbitrary and well-defined way to approach the contentious problem of allocation and create shared expectations. Equity principles also coordinate and legitimate distributive choices. Equity principles help strike a balance between competing points of view.

Besides evaluating different allocation impacts for equity, all formulae are based upon the normative ethical principle, Aristotle's Equity (Proportionality) Principle. Aristotle's Equity Principle is the most appropriate normative ethical principle for distributing a single, homogenous, and divisible "good" that can be cardinally measured by a common metric, here days or capacity, and claims – for days – can be compared by some numerical measure of entitlement.[8] Thus shares (PAES) are in proportion to the differences of claimants, whether the differences are defined and measured as historical days or m^3 of well capacity.[9]

[7] Multiplying daily vessel operating profit by different TAE to give annual daily vessel operating profit does not qualitatively change the overall results of this analysis. That is, the conclusions hold for annual as well as daily vessel operating profit for the entire fleet.

[8] "Equals should be treated equally, and unequals unequally, in proportion to the relevant similarities and differences." Four principles guide the definition of relevance in Aristotle's Equity Principle: compensation, reward, exogenous rights, and fitness (allocate the resource, here days, to the party that makes the best use of them, justifying unequal allocation of resources independently of needs, merits, or rights).

[9] Compensation or reward are sometimes invoked when there are individual characteristics of claimants (e.g. inequality of resources or unequal responsibility in contributing to the greater good) deemed relevant to fairness. In this case, however, historical days (over an extended period of time to remove the impact of random events) and m^3 of well capacity are uniform characteristics that apply equally to all claimants. Besides exogenous rights compensation, and reward as principles of distributive justice, fitness – defined here as economic efficiency -- forms the fourth. Exogenous rights correspond to equality *ex ante* of the allocation and compensation and reward correspond to *ex post* of the allocation. This analysis relies upon the two principles that are applicable to the situation at hand, exogenous rights and efficiency (fitness).

Other Regional Fisheries Management Organizations, whether tuna or deep-water, develop lists of criteria, both ordinal (qualitative) and cardinal (quantitative), upon which to base allocation formulae. Some criteria are intended to specify which parties are legitimate claimants and the nature of their claims. Such an approach requires choice of variables, quantifying the qualitative ordinal criteria, a weighting formula for the different variables, and a functional form for the formulae used to combine the weighted variables. The Priority Principle with point lists is the most widely used approach in these instances (when there are heterogenous and/or indivisible "goods" to be allocated). However, an allocation formula based upon multiple criteria and the Priority Principle is not appropriate in this instance because: (1) an exogenous right – capacity – has already been established and allocated through Resolution C-02-03 (thereby establishing the legitimate claimants and their claims) and (2) both historical nominal days and capacity are homogenous in composition, divisible, and can be readily cardinally measured (making Aristotle's Equity Principle the appropriate normative ethical principle for allocation).

Beside evaluating outcomes for equity, the analysis also evaluates what outcomes are fair from an *a priori* standpoint (including application of Aristotle's Equity Principle). The analysis deems it *fair* to allocate each claimant (here vessel) its fair share of the days (here based upon Aristotle's Equity Principle), because these are the portions the claimants (vessels, Flag States) are entitled to (based on exogenous rights). The analysis also deems it *fair* according to the decision-making process (discussed below). The analysis also states that the allocation is *efficient* if no other allocation makes everyone as well off and someone better off. Moreover, an allocation is *acceptable* if no claimant is no worse off than the claimant's initial entitlement. An allocation should also be *transparently equitable* in that no claimant should receive a smaller share than another claimant with an equal share. More generally, no claimant should receive a smaller percentage of the allocation than the claimant's share warrants, relative to the shares of the other claimants. An allocation should also be *consistent* in that every subgroup (e.g. capacity class, DML/no DML, Flag State) should fairly divide the days allotted to them as a group. Another way of stating *consistency* is that an allocation which is fair to the entire IATTC as a whole should be fair from the standpoint of each subgroup (capacity class, DML/no DML, individual Flag States). Consistency creates stability and *impartiality*. The allocation should also be *replicable* IN that every fair allocation for a given subgroup should be fair when imitated by similar subgroups. An allocation should also increase overall welfare when the Total Allowable Effort grows.

The concept of *fair division*, which is closely related to equity, was also incorporated into the analysis to provide a more comprehensive approach to procedural and distributive justice.[10] Fair division is inherent to any PAES allocation, since CPC decision-making in the IATTC is voluntary, consensual, and not imposed by a third party, all CPCs have equal exogenous rights and parity, and only CPCs have legal personality in the IATTC. This fair division makes any PAES a fair share or fair PAES.

The resulting analysis develops PAES allocation formulae that have equity and fair division in process through the IATTC decision-making process and Aristotle's Equity Principle, giving process justice, and outcomes through IATTC decision-making and evaluation of outcomes by equity metrics, giving distributive justice. These approaches to process and distributive justice also contribute to Environmental Justice (which is fundamentally about disproportionate impacts).

[10] Fair division is the problem of dividing a "good(s)" among two or more parties in a way that satisfies a suitable fairness criterion. Most fair division problems resolve around the question of how differences in claims (due to disparities in merit, contribution, need, etc.) should be considered. The central tenet of fair division is that such a division should be: performed by and according to the valuations of the claimants themselves, maybe using a mediator but not an arbiter, rather than a third party such as an institution or policy maker, since only the claimants really know how they value the "good(s)." From a procedural point of view, the decision must be unanimous. Claimants may be treated unequally, since some claims are stronger than others, and exogenous rights may differ.

Exogenous Rights and Claims

A PAES allocation has to consider two exogenous rights (i.e. exogenous to the allocation of days and the process of fishing) and accompanying claims, the rights of IATTC Contracting Parties to the Convention with a Flag State right and the right to m^3 of purse seine vessel well capacity established by Resolution C-02-03. Resolution C-02-03 also establishes precedents. Flag State rights are equal, and the PAES allocation is made to vessels through CPCs. The capacity right differs from a right based solely upon even division for each vessel. In addition, one unit of capacity, as an exogenous right, corresponds to equality *ex ante*, in the sense of an equal claim for each unit of capacity. Differences in total claims for PAES based upon total m^3 of capacity can differ, since exogenous rights for total capacity differ in proportion to the m^3 of well capacity of a purse seine vessel.

Historical days are not exogenous rights with accompanying claims, since the IATTC has not established historical days as a right. Instead, historical days reflect historical patterns of activity. In the absence of an established exogenous right, historical days could provide sufficient legitimacy even though not an exogenous right. Moreover, the transferable day scheme is a credit system in which a vessel's days are a limit and not a property right. The credit system does not establish an exogenous right and accompanying claim by Flag States or vessels for days.

Nonetheless, historical days and their associated daily vessel operating profits can be viewed as an opportunity cost or a floor for a vessel's share.[11] Thus, a PAES allocation scheme that generates annual vessel days that are substantially less than historical usage may not be *acceptable* compared to another PAES scheme that more closely conforms with historical days. Moreover, no vessel after the transferable day credit program has been implemented should earn less than their *status quo* daily vessel operating profit, making an *acceptable* allocation. In this way, all vessels in the aggregate gain and no individual vessel loses daily vessel operating profit. No vessel or Flag State should be penalized for joining the cooperative scheme. Moreover, any rational allocation scheme should at least cover opportunity costs and thus be *acceptable*.

For each PAES, vessel daily operating profit increases or is essentially unchanged from before following the transferable day credit program, indicating that vessels' opportunity costs or floor is satisfied. That is, there is an aggregate gain for all vessels and no vessel is made worse off.

Definitions of Alternative PAES

Vessel historical days PAES are calculated as follows, where the two different definitions of historical days used to calculate PAES give two versions of the following formula:[12]

$S_i = \frac{Days_i}{\sum_{i=1}^{N} Days_i}$ = Proportional Allowable Effort Share (PAES), where:

i = vessel i

$Days_i$ = vessel i's historical days as the measure of effort

N = number of vessels

[11] An opportunity cost is the value of the next best alternative.

[12] Any of these PAES allocations are economically efficient (what is called Pareto optimal), since one State Party's share increases only when another's decreases and none is thrown away.

$0 < S_i < 1$ and $\sum_{i=1}^{N} S_i = 1$.

Vessel i's Allowable Effort in Management Year= $S_i * Total\ Allowable\ Effort$

The historical days formula Average 3 Years is each vessel's day averaged over 2016-2018.

The historical days formula Best X of Y is each vessel's days chosen as:

a) Out of the most recent 5-year effort history, each vessel is allocated an average of its best 3 years of effort out of the most recent 5 years the vessel has been active on the regional vessel register.
b) The average 3 out of the most recent 4 years of effort if a vessel has only been active on the regional vessel register 4 out of the past 5 years.
c) The average 2 out of the most recent 3 years of effort if a vessel has only been active on the regional vessel register 3 out of the past 5 years.
d) The average 1 out of the most recent 2 years of effort if a vessel has only been active on the regional vessel register 2 out of the past 5 years.
e) A vessel active on the regional vessel register for 1 out of the past 5 years receives its effort for that one year.

PAES based upon vessel historical capacity, called Days per m^3 of Capacity, are calculated in a similar manner:

$S_i = \frac{Capacity_i}{\sum_{i=1}^{N} Capacity_i}$, where:

$Capacity_i$ = purse seine vessel i's historical capacity measured in m^3 of well capacity for vessels on the Regional Vessel Register.

The resulting days from this application can be called days-capacity.

The hybrid PAES, which represents a compromise between historical days and capacity, is calculated as follows. Each vessel i is assigned one of the following days-hybrid:

$Days_i - Hybrid_i = Days_i$ if $Days_i > Days_i - Capacity_i$

$Days_i - Hybrid_i = Days - Capacity_i\ if\ Days_i < Days_i - Capacity_i$

Once this assignment has been made, then Hybrid PAES are calculated as follows:

$$PAES_i = \frac{Days_i - Hybrid_i}{\sum_{i=1}^{N} Days_i - Hybrid_i}$$

Vessels were allowed a maximum of 300 $Days_i - Hybrid_i$.

The advantage of allowing vessels to choose either $Days$ or $Days_i$ or $Days_i - Hybrid_i$ is that the vessels voluntarily choose based upon their own best interests, rather than imposed by a third party, giving fair division and a fair process and fair bargain,[13] and neither weights for historical days and capacity or a weighting formula are required.

Once a PAES formula has been selected, each Management Year a vessel i receives an allocation of days through its Flag State Contracting Party to the IATTC as follows:

$$Days_i^* = PAES_i \; x \; TAE$$

<u>*Key Results*</u>*:*

The maximum potential daily vessel operating profit results following introduction of the transferable day scheme are:

- *Best X of Y > Average 3 Years > Hybrid of Best X of Y and Days/m³ Capacity > Days/m³ Capacity*
- *Some vessels displayed negative vessel daily vessel operating profit before the transferable day credit scheme.*
- *Some vessels still displayed negative daily vessel operating profit after the scheme but a lower amount.*
- *Some vessels displayed no change in daily vessel operating profit after the scheme, since these vessels were already optimally performing.*
- *The changes in daily vessel operating profit following the transferable day credit scheme are due to improved vessel operations from more flexible fishing.*
- *Previous research for simulated multi-vessel companies, whereby (artificially constructed) companies can choose the optimum combination of days for each vessel, indicates that multi-vessel companies can expect considerable larger gains in daily vessel operating profit.*[14]

The relative sizes of PAES overall and by Flag State are similar and stable for the different PAES allocation schemes.

[13] Such an approach may also satisfy another well-known fairness criterion, no-envy, at least from a certain perspective. An envy-free distribution occurs if no claimant prefers another's portion of a particular allocation of a "good" to one's own. Envy-free distribution requires divisible "goods" and parties with equal claims. Here, the claims are equal in the sense that when the unit is day or m^3 of well capacity are equal among claimants (vessels and Flag States) although the total holdings by each vessel when differentiated by days or m3 of well capacity are not equal.

[14] Multi-vessel companies were constructed for each Flag State by randomly selecting vessels. The data do not allow identifying individual vessels, including the company owning vessels.

Equity and Distributive Justice

Equity metrics for daily vessel operating profit before and after the transferable day credit scheme for different PAES allocation formulae indicate that the different PAES allocation formulae give very similar equity results for vessels.

Comparing inequality in the distribution of daily vessel operating profit before and after the transferable day credit program, inequality slightly increases under the Best X of Y scheme and slightly decreases under the Average 3 Years, Days/m^3 Capacity, and Hybrid schemes. These changes are minor.

Choice of PAES allocation scheme with regard to distributive justice, as defined by equity of the distribution of daily vessel operating profit by vessels, is fundamentally unaffected. That is, distributive justice as measured by equity metrics is very close for all four PAES schemes at the vessel level.

Equity and distributive justice can also be evaluated for the allocated fair PAES to individual vessels using the same equity metrics. Best X of Y, Days/m^3 Capacity, and Hybrid all display a high degree of equity, with the order in terms of increasing inequality of allocated PAES from highest equality to lowest equality: Hybrid > Best X of Y > Days/m^3 Capacity, with Hybrid and Best X of Y difficult to distinguish between.

Overall Conclusion

IATTC decision-making and the application of the normative ethical principle Aristotle's Equity Principle as the basis of allocations, along with the other equity principles discussed above, contribute to procedural justice. The application of equity metrics to evaluate the impact upon PAES and daily vessel operating profit contribute to distributive justice.

Fair PAES allocation schemes can be defined by the exogenous right of m^3 of vessel well capacity or historical days (reflecting historical activity and not an exogenous right) or a hybrid of both for purse seine vessels active on the Regional Vessel Register.

While not an exogenous right with an accompanying claim on days, historical days and historical daily vessel operating profit provide a floor and opportunity cost (what a vessel would have to forgo) for any fair PAES allocation scheme, and especially one that is capacity-based.

Aristotle's Equity Principle, giving *ex ante* equitable PAES allocations proportional to capacity and/or historical days, is the appropriate normative ethical principle upon which to base an allocation of days and contributes to procedural justice.

Equity and distributive justice for daily vessel operating profit (as indicated by multiple equity metrics) are very close for all four fair PAES allocation schemes, and hence do not materially impact the choice among the PAES allocation schemes.

The order of economic efficiency (measured by daily vessel operating profit) from highest to lowest is: Best X of Y > Average 3 Years > Hybrid of Best X of Y and Days/m^3 Capacity > Days/m^3 Capacity.

The Hybrid PAES, in which vessels receive PAES based upon whichever is greater, historical days or m^3 of well capacity, gives a compromise between historical days (opportunity cost) and capacity (exogenous right). Allowing vessels to choose between days or capacity gives a fair process. Some transfer of days occurs to vessels with fewer historical days per m^3 of well capacity when compared to Best X of Y (historical days), but this transfer is capped since $Days - Capacity$ is capped at 300 days, may be implicitly compensated by the increase in daily vessel operating profit, and compensation is possible as discussed under Caveats.

Final Recommendation:

Equity of daily vessel operating profit (outcome) and allocated fair PAES and thereby distributive justice are very close among all four PAES. Procedural justice is inherent to the process. All four PAES are fair

and based upon the normative ethical principle, Aristotle's Equity Principle. The recommendation can then be based upon economic efficiency and balancing competing ideas about the nature of claims (days or capacity).

This study recommends either: (1) the Best X of Y PAES allocation scheme for greatest economic efficiency or (2) the Hybrid PAES allocation scheme as a compromise between PAES allocation based upon historical days (representing opportunity costs and historical activity) and capacity (representing an exogenous right). The Hybrid PAES allocation scheme allows compromise of competing types of claims and claimants (Flag States, vessels) and more directly draws upon Resolution C-02-03 (establishing the exogenous right).

Caveats:

This study did not explicitly address US purse seine vessels primarily fishing in the Western and Central Pacific and only secondarily fishing in the Eastern Pacific Ocean or other purse seine vessels fishing less than 99 days. However, these special cases can be readily accommodated by, for example, either allocating days based upon some agreed upon number of historical days or days-capacity comparable to other Class 6 vessels with or without a Dolphin Mortality Limit/setting on floating objects (for Best X of Y), or their m^3 of well capacity.

The analysis also set an upper limit of 300 $Days - Capacity$ for each vessel. This upper limit was close to the maximum observed historical days for vessels. Any days beyond 300 were not reassigned to other vessels (and could be reassigned based upon Aristotle's Equity Principle). The overall results would not appreciably and qualitatively change with such adjustments.

While no vessel loses in daily vessel operating profit under the Hybrid PAES allocation formulae, a vessel could conceivably lose in annual vessel operating profit if that vessel's historical days were high relative to its capacity compared to other vessels and depending upon the TAE. Thus, the Hybrid PAES could conceivable transfer enough days away from these vessels to reduce their historical days' annual vessel operating profit, even though their daily vessel operating profit increased. Such a PAES is not *acceptable*. Further analysis is required on this issue. Such a vessel could conceivably be compensated by: (1) receiving any surplus days beyond the 300 $Days - Capacity$ for each vessel, (2) or by proportionately transferring days from all vessels (Aristotle's Equity Principle), (3) or by lowering the 300 $Days - Capacity$ for each vessel by an amount sufficient to create a large enough surplus for reassignment and compensation (uniform loss solution). The overall results would not appreciably and qualitatively change with such adjustments.