AGREEMENT ON THE INTERNATIONAL DOLPHIN CONSERVATION PROGRAM

30TH MEETING OF THE PARTIES

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DOCUMENT MOP-30 INF-A

OPTIONS FOR ASSESSING THE STATUS OF DOLPHIN POPULATIONS IN THE EASTERN PACIFIC OCEAN

1. BACKGROUND

The stock status of dolphin species in the eastern Pacific Ocean (EPO) historically has been monitored using population dynamics modelling (Gerrodette and Forcada 2005, Reilly *et al*. 2005, IATTC 2006; Wade *et al*. 2007, Gerrodette *et al*. 2008), and abundance estimates from these models are used to establish the per-stock per-year dolphin mortality caps for the purse-seine fishery (IATTC 2006). Population dynamics models require indices of abundance which, for EPO dolphins, have been developed from both fishery-dependent and fishery-independent data. Abundance trends were estimated from purse-seine fisheries observer data from the mid-1970s until the late 1990s (Buckland and Anganuzzi 1988; Anganuzzi and Buckland 1989; Buckland *et al*. 1992). However, trend estimation was discontinued in 2000 due to concerns about changes in vessel search behavior over time (Lennert-Cody *et al*. 2001), and additional concerns have been raised about potential issues associated with the non-random search (Lennert-Cody and Maunder 2014) and herd size (Ward 2005). Analysis of the purse-seine observer data is ongoing in preparation for discussion at the 2015 IATTC Scientific Advisory Committee meeting, but at present it appears doubtful that indices of relative abundance for dolphins developed from the purse-seine observer data can be used to reliably track abundance trends. Between 1979 and 2006, the US National Marine Fisheries Service (NMFS) conducted periodic fishery-independent surveys in the EPO for the purpose of estimating dolphin absolute abundance (Gerrodette *et al*. 2008, and references therein). It has now been over seven years since the last NMFS survey, and the status of future surveys is unclear. Thus, at present, there is no reliable data source with which to conduct population dynamics modelling or evaluate the status of EPO dolphin stocks.

In response to a request at the 29th Meeting of the Parties, this document provides a preliminary overview of several options for assessing the status of dolphin populations, including: 1) updating the historical NMFS survey time series using research vessels, 2) establishing an international survey program using purse-seine vessels as survey platforms, and 3) using alternatives to line-transect surveys, such as mark-recapture, genetics, and life history.

2. UPDATING THE NMFS TIME SERIES WITH RESEARCH VESSEL SURVEYS

2.1. Most recent survey methodology

The methodology used in the most recent NMFS survey, summarized below, is described in Gerrodette *et al*. (2008); the field methods section of Gerrodette *et al*. 2008 is reproduced in Appendix A. The study area (Appendix A, Figure 1) covered much of the tropical EPO, with emphasis on a core sub-region occupied by the northeastern stock of offshore spotted dolphin (*Stenella attenuata*) and the eastern spinner dolphin (*Stenella longirostris orientalis*), the two stocks most involved with the purse-seine fishery. Two research vessels conducted the survey during a continuous 4-month period between late July and early December, in 2006, during which time over 21,000 km of on-duty searching was conducted (Appendix A, Table 1). A strict sampling protocol was followed on both vessels[1]. Each vessel carried a seven-person search team, comprised of a scientific coordinator and two teams of three observers, highly skilled and experienced at sighting and identifying marine mammal species. Teams searched in two-hour

[1] 2006 NMFS *Cruise instructions David Starr Jordan* and *Cruise instructions McArthur II*

shifts during daylight, using two sets of pedestal-mounted 25X binoculars (outfitted with azimuth rings and reticles), and one pair of hand-held binoculars. Data for each sighting (angles, dolphin species and herd size) were entered into a customized computer database in real time, with the position recorded automatically from the ship's Global Positioning System. Abundance estimation was based on sightings and search effort during daylight hours with low Beaufort sea state (≤ 5) and good visibility (≥ 4km). Observer estimates of dolphin herd size were individually calibrated using aerial photogrammetry data collected either with a helicopter carried aboard one of the ships for the entire 4 month period, or on a separate, roughly 1-week-long calibration cruise with both ships, conducted in partnership with a fixed-wing aircraft outfitted with camera equipment. Abundance estimates were computed using line-transect methodology, with special consideration given to standardizing line-transect parameters for different survey conditions (*e.g.* sea state, swell height, time of day), different survey platform characteristics (different research vessel characteristics), and the method of sighting (binocular type), among other factors.

2.2. Survey costs

In 2013, NMFS estimated the costs for a survey[2], using research vessels operated by the US National Oceanographic and Atmospheric Admininistration (NOAA), at US$ 5.97 million (in 2012 dollars), not including other associated costs such as land-based logistical support, and data processing and analysis[1].

The largest budget item is the cost of the research vessel. The estimated daily cost of each NOAA research vessel in 2013 (including crew) was US$ 15,000, or US$ 4.35 million for a 240-sea day, 2-vessel survey (which includes 25 port days per vessel). However, the availability of NOAA research vessels has been a major obstacle to planning additional surveys since 2007, so using non-NOAA platforms should be considered. One option would be to charter non-NOAA research vessels. For example, the *Ocean Starr* (formerly the *David Starr Jordan*), used in previous dolphin survey cruises, is now privately owned, and could be contracted at a rate of approximately US$ 18,500 per day. At that rate, the vessel costs would increase to US$ 5.37 million.

Scientific operations account for the remaining US$ 1.6 million. Of this, US$ 1.1 million represents costs directly related to dolphin abundance estimation. Some of the projects undertaken during the 2006 survey were not integral to the production of dolphin abundance estimates from line-transect data: specifically, cetacean acoustic sampling (US$ 122,000) and ecosystem sampling (US$ 389,000). It should be noted, however, that interpretation of abundance estimates is best accomplished in an ecosystem context so as to separate environmental variability in any given survey year from long-term population trends. For this reason, some ecosystem sampling is advised.

3. SOME IMPORTANT CONSIDERATIONS

3.1. Research vessel availability

As noted above, one of the two research vessels previously used by the NMFS (*David Starr Jordan*) is operational, but is now privately owned. It is not known if the other vessel (*McArthur II*) is operational. No other NOAA research vessels have been used for EPO marine mammal surveys, and additional planning, testing, and calibration would likely be required prior to use in any survey.

3.2. Standardizing for differences in survey platforms, gear and environmental conditions

Differences in survey vessels and/or configuration of survey equipment aboard each vessel (*e.g.* height of binoculars from the water), survey equipment capabilities (*e.g.* binocular power) and environmental conditions (*e.g.* sea state) can all affect the resulting estimates of abundance. Modelling and standardizing for the effects of these various factors requires sufficient sightings data. Roughly 60-100 sightings are necessary to be able to model covariate effects on line-transect parameters. To put this number in context, during the 2006 4-month NMFS survey there were a total of 134 sightings of offshore spotted dolphins and 68 sightings of eastern spinner dolphins (Appendix A, Table 1). Therefore, the sample sizes necessary to adjust for differences among vessels, seasons, weather, *etc*., are considerable, although in some instances data for several species might be pooled. This is particularly

[2] NMFS Cetacean and ecosystem assessment surveys in the Eastern Tropical Pacific: overview and cost

important as regards survey design, for either research vessels or tuna vessels (see below), because it implies that fewer vessels should be used for longer periods of time, rather than more vessels, each for only a short period.

3.3. Herd size calibration

Estimating the number of dolphins in a herd accurately is difficult, and therefore calibrating the observers' herd size estimates is critical to improving the accuracy of the abundance estimates. The calibration correction can have a strong effect on the estimates of abundance (Gerrodette *et al*. 2008), so this is an important component of survey data collection. The data used to calibrate the herd size estimates are collected on designated calibration cruises, involving both the research vessels and an aircraft, typically conducted in areas of high dolphin density (to increase sighting rates) and during favorable weather conditions. Observers' ship-based estimates are compared to the aerial photogrammetry estimates to correct for individual observer tendencies to under- or over-estimate dolphin herd size. Estimates of mean herd size by observers on tuna purse-seine vessels are 4-5 times higher than estimates from research vessels (Ward 2005), so calibration of herd size estimation may be particularly important if tuna vessels and observers were to be used for the survey (see below).

3.4. Survey area and period

The NMFS survey was designed to provide information on the status of a number of dolphin species. If a new survey were designed with the goal of focusing only on abundance estimates for the northeastern offshore spotted dolphin and eastern spinner dolphin, the survey design might include a redefinition of the survey area. For example, the search effort far to the west and south of the northeastern offshore spotted dolphin core area (Appendix A, Figure 1) could be redistributed into a buffer zone around that core area and/or within the core area itself. Such a modification might improve the precision of the abundance estimates for the primary stocks of interest. In addition, surveys outside the July-December period might be considered to increase effort (and therefore improve precision), but poor survey conditions due to weather (*e.g.* high Beaufort) during other times of the year may be problematic. Ultimately, the experimental design of a new research survey should include consultations among NMFS, IATTC staff, scientists from AIDCP Parties, and other experts.

3.5. Land-based logistical support

Surveys require a number of people to prepare, pack, load, and install equipment aboard the research vessels. In addition, permits need to be obtained from coastal countries to survey in their waters. For past surveys, NMFS initiated the permitting process nine months to one year in advance, and relied on more than a dozen people for land-based logistical support, at an estimated cost of US$ 700,000 per survey. Current IATTC staffing levels would not allow the IATTC staff to provide this level of logistical support and still meet all of their other obligations.

3.6. Data analysis

The estimation of abundance from any new research surveys should be a collaborative effort among scientists from IATTC, NMFS, and other interested parties.

4. LINE-TRANSECT SURVEYS USING PURSE-SEINE VESSELS

4.1. Survey costs

The possibility of using large purse-seine vessels from the international tuna fleet as survey platforms for conducting dolphin line-transect surveys was discussed at the 29th Meeting of the Parties. It is not clear that this option would be cost-effective: the limited information available suggests that operating costs for class-6 purse-seine vessels are similar to, or possibly greater than, research vessels. Exact costs will depend on the size and age of the vessel, on country-specific costs of fuel and insurance, and on helicopter costs (for vessels with helicopters). As an example, it is estimated that a large purse-seiner could cost between about US$ 15,500 and 25,200 per day. Because the vessels would need to follow strict survey protocols and use pre-determined track lines, there would be no opportunities to offset vessel costs with tuna-fishing activities.

Before surveys by tuna vessels could be conducted, one or more meetings would be required to develop a design and protocols for the survey, and a plan for logistical support. Additional meetings would be required to plan and conduct data analyses. These meetings should include NMFS and IATTC staff, and scientists of other interested parties.

4.2. Conducting surveys during fishery closures

Without a thorough analysis of survey options, it is not clear whether surveys conducted only during a fishery closure would result in sufficient numbers of sightings per vessel to allow for standardization of differences among vessels. Roughly 200 sightings of offshore spotted dolphins and eastern spinner dolphins were obtained from the 2006 NMFS survey, with two research vessels operating for a 4-month period (Table A1), which all else being equal, is at most twice the number of sightings per vessel recommended to be able to standardize for differences in survey platform characteristics and in environmental conditions (see above). This suggests that perhaps 3-4 vessels operating for less than 4 months might be feasible, but this is far from certain without a detailed study of previous survey variability. Regardless, if large numbers of purse-seine vessels were to survey for short periods of time during a closure, it is unlikely that the the number of sightings per vessel would be sufficient to make standardizing for differences among vessels possible, and these differences would result in greater uncertainty in the estimates of abundance.

4.3. Absolute versus relative abundance

Another important consideration is whether indices of dolphin abundance based on purse-seine vessel surveys should stand alone or could be used to extend the previous research vessel survey estimates. The NMFS surveys were designed to estimate absolute abundance. In principle, if the bias is low, they can be compared with any other low bias estimates of abundance, while taking the estimation uncertainty into consideration. This has the advantage that any new method to estimate absolute abundance does not have to follow the same protocol, only that it is a low bias, and preferably a low variance, estimate of absolute abundance. However, if the estimates are biased in the sense that they only provide information on relative abundance, then the same protocol should be used or some form of calibration (standardization) should be conducted. Importantly, if there is no overlap in time between the two surveys types (research *versus* tuna vessel), it will not be possible to standardize for any indirect (or direct) differences in effects of the two survey platforms; any differences attributable to vessel types cannot be unequivocally separated from changes over time in dolphin abundance. This could be an important consideration if, for example, dolphin herds respond differently to tuna vessels (*e.g.*, level of evasive response) compared to research vessels. It is also worth noting that since the main goal of any survey is to detect changes in abundance and these changes occur slowly over time, creating a new index of relative abundance will not be beneficial in the short term.

5. ALTERNATIVES TO LINE-TRANSECT SURVEYS

5.1. Mark-recapture methods

Abundance can also be estimated using mark-recapture techniques. Tagging would require an initial capture to attach the tag to the animal, and subsequent visual "recaptures" of tagged individuals by observers. Tagging studies of dolphins have been conducted previously in the EPO (Scott *et al*. 1990; Scott and Chivers 2009), and while much was learned about behavior, movements, and migration patterns, the number of tag returns was not high enough to estimate abundance. Tagging methodology has improved, but further discussion and investigation is needed to determine how they could be applied on a large scale to EPO dolphins for the purpose of monitoring abundance. Also, there is the need to accurately estimate the level of tag losses, to help determine the required sample size and to correct for bias in the population estimate.

The AIDCP Scientific Advisory Board (SAB) previously reviewed a proposal (SAB-02-08a) about the potential for using Passive Integrated Transponder (PIT) tags to estimate population size. An animal is "marked" when the PIT tag is implanted internally (thus reducing tag loss) and "resighted" when a receiver detects the presence of the PIT tag during a purse-seine set. An expert workshop would be required to determine the viability and practicality of PIT tags for estimating population size using mark-recapture methods.

Genetic mark-recapture techniques (*e.g.* Pearse *et al*. 2001) and "close-kin analysis" methods (*e.g.* Skaug 2001; Bravington *et al*. 2014), use genetic information to estimate abundance. Mark-recapture methods require an initial sample for marking and a subsequent recapture sample; close-kin methods require sampling of both adults and juveniles, with sampling of juveniles independent of that of adults. Both methods require genetic markers for dolphin species to be developed, and also require genetic analyses in the laboratory. Estimates of these costs are not currently available.

All of these mark-recapture methods would require development of a sampling design, and some of them would require extensive ship time aboard tuna purse seiners, either vessels that are allowed to fish during closure periods or vessels that are chartered for dedicated research cruises, to mark individuals. For mark-recapture genetics methods, it may be practical to take both the initial (marking) samples and the follow-up (recapture) samples on commercial vessels during normal operations, but this would require assistance from vessel crew and/or would require the observers to perform additional duties, perhaps at the expense of some of the data currently collected. Costs are difficult to estimate. Based on genetics literature and the 2006 estimates of dolphin abundance, tissue samples from about 10,000 northeastern offshore spotted dolphins would need to be collected during each phase for the mark-recapture study; for close-kin analysis, samples from about 6,000 animals would be required in the first year, but perhaps fewer samples in subsequent years. Using the maximum number of animals biopsied during the NMFS CHESS cruises (27 animals in one dolphin-set), and assuming 1 dolphin-set per day, genetics sampling using the close-kin method would require over 220 sea-days, and more for the mark-recapture method. This is comparable to the 240 sea-days estimated for the NMFS surveys. For close-kin methods, it may be possible to obtain samples from dead animals only, but at the current annual mortality level of less 1,000 animals, it would take several years to obtain even the initial sample.

5.2. Life history sampling

Life history data have been collected from dolphins that have died in purse-seine sets since the 1970s: length, sex, reproductive organs, stomach contents, teeth (for estimating age), and color phase in spotted dolphins (an indicator of age class). Life history studies have been a mainstay of research on dolphins in the EPO and much data were collected by the NMFS until the mid-1990s. Life history sampling was a part of the initial mandate of the SAB (Document IRP-33-11a), and in 2005 a proposal to re-initiate sampling by AIDCP observers (SAB-02-04) was recommended by the SAB (minutes of the 2nd meeting of the SAB), and approved at the 14th Meeting of the Parties. However, the necessary funding has not been available.

The results from life history studies, such as age distributions and population growth rates, can provide basic inputs for integrated population modelling (see below), while food habits data can provide an insight into environmental changes affecting population condition. Life history data can reveal indications of population growth or decline, although the data often need to be interpreted in light of other data: current and historical mortality, environmental changes, and previous population estimates. Conversely, life history data may provide insight on abundance trends, for example, when populations approach the carrying capacity of their environment.

One advantage of life history data is that the cost is low relative to large-scale surveys. The approximate cost would be US$ 255,000 for each of the first two years, but costs should decrease in subsequent years. Unlike line-transect surveys that require dedicated vessels, the sampling can be done by observers already aboard tuna vessels. One disadvantage is that, because current mortality is so low, the data collection would need to be long-term and continuous to 1) gather a sample size adequate to compare with older data, and 2) provide ongoing monitoring of the population in the future.

5.3. Integrated population modelling

Population dynamics models can be used to assimilate information from multiple data sources. This approach allows more flexibility in the type of data that are collected and used to evaluate abundance trends. However, the information content of the data may be highly dependent on uncertain assumptions about the population dynamics. Hoyle and Maunder (2004) applied an integrated model to the northeastern offshore spotted dolphin population using survey estimates of absolute abundance and age and color-phase composition of the mortalities. Mortality rates are currently low, so the composition data are sparse. It might be possible to collect color-phase or length composition data from aerial photographs or other sources, but these will have to be treated separately from the mortality composition data, and ages will probably not be available.

6. CONCLUSIONS

Detailed analyses would be required to adequately evaluate the feasibility of the various options for assessing dolphin population status, and to rigorously estimate and compare costs. Nonetheless, several general conclusions can be made. It is clear that the main cost of research vessel line-transect surveys is the cost of the vessel, and that costs would likely be similar or greater if purse-seine vessels were chartered instead of research vessels. While some of the alternatives to line-transect surveys discussed above, such as genetic mark-recapture, are new and potentially powerful techniques, they will require a research and development phase, and are thus unlikely to provide information on abundance in the short term. Life history-based population status indicators, which are relatively inexpensive with respect to data collection, may not by themselves be adequate to monitor abundance trends, but can be valuable for evaluating population status when combined with other information through integrated population modelling.

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APPENDIX A.

METHODS (from Gerrodette *et al*. 2008)

Study area and stratification

The 2006 study area was the same as for the 1998-2000 and 2003 cruises. The study area extended from the US/Mexico border south to the territorial waters of Peru, bounded on the east by the continental shores of the Americas, and to the west by Hawaii, roughly from 32° N to 18° S latitude, and from the coastline of the Americas to 153° W longitude (Fig. 1).

Survey effort within the study area was stratified according to the geographic distribution of the two stocks which have been most affected by the fishery: the northeastern offshore stock of the pantropical spotted dolphin, *Stenella attenuata attenuata*, north of 5°N and east of 120°W (Perrin et al. 1994), and the eastern spinner dolphin, *Stenella longirostris orientalis* (Perrin 1990). Northeastern offshore spotted dolphins are found only in the Core stratum by definition, and eastern spinner dolphins are found primarily in the Core and Core2 strata (Fig. 1), so search effort per unit area was, by design, higher in these strata (Fig. 2). Within each stratum, transect lines were randomly but not uniformly spaced, given the logistical constraints of ship range and speed. Ships moved at night, which contributed to some independence among daily transects. The starting point of each day's transect effort was wherever the ship happened to be at dawn along the overall trackline.

The STAR06 survey was carried out with NOAA Ships *David Starr Jordan* and *McArthur II* between July 29 and Dec 7, 2006, the same time as previous surveys (Jackson et al. 2008). The *Jordan* has been used for ETP cetacean surveys for many years. It is 52.1m in length and has an observer eye height of 10.7m. The *McArthur II* was used on ETP surveys for the first time in 2003. It is a larger ship, with a length of 68.3m and an observer eye height of 15.2m.

Ships, study area and stratification in earlier years are described in Gerrodette and Forcada (2005). This report includes data from 10 ETP cruises carried out in 1986-1990, 1998-2000, 2003 and 2006.

Field methods

Methods of collecting data in all years followed standard protocols for line- transect surveys conducted by the Southwest Fisheries Science Center (Kinzey et al. 2000). In workable conditions, a visual search for cetaceans was conducted on the flying bridge of each vessel during all daylight hours as the ship moved along the trackline at a speed of 10 knots. The team of 3 observers rotated positions every 40 minutes; thus, each observer stood watch for 2 hours, then had 2 hours rest. Two observers, one on each side of the ship, searched with pedestal-mounted 25x150 binoculars. In 2003 and 2006, each 25X observer scanned from abeam (90° from the trackline) to the trackline. Together, the two 25X observers thus searched the 180E forward of the ship. This was a slight change from searching protocol prior to 2003. On cruises before 2003, each observer scanned from abeam to 10° past the trackline on the opposite side; thus, there was a 20° area of overlap near the trackline. The 25X binoculars were fitted with azimuth rings and reticles for angle and distance measurements. The third observer searched by eye and with hand-held 7X binoculars, covering areas closer to the ship over the whole 180° forward of the ship.

When a marine mammal was sighted, the horizontal and vertical angles to the sighting were measured, and the third observer entered the data in a computer using a customized data entry program, WinCruz. The program computed the radial and perpendicular distances to the sighting based on these angles (Kinzey and Gerrodette 2003). If the sighting was less than 5.6 km (3.0 nautical miles) from the trackline, the team went "off-effort" and directed the ship to leave the trackline and approach the sighted animal(s). The observers identified the sighting to species or subspecies (if possible) and made school-size estimates. Each observer team had at least one observer who was highly experienced in the field identification of marine mammals in the ETP. Observers discussed distinguishing field characteristics in order to obtain the best possible identification, but they estimated school sizes and, in the case of mixed-species schools, school composition, independently. The computer was connected to the ship's Global Positioning System to record the position of each sighting and all other data events.

Effort and sightings

Estimation of dolphin abundance was based on search effort and sightings that occurred during on-effort periods. We used sightings and effort in conditions of Beaufort sea state ≤ 5 and visibility ≥ 4km, discarding a small number of sightings and low amount of effort beyond these conditions. Sightings and effort within a day were summed; thus, one day of search effort was considered the sampling unit for purposes of variance estimation. If the ship crossed a stratum boundary during a day, separate transects were recorded for each stratum.

In this report, we consider sightings and estimate abundance for the following species and stocks: spotted (*Stenella attenuata*, northeastern offshore, western/southern offshore, and coastal stocks), spinner (*S. longirostris*, eastern and whitebelly stocks), striped (*S. coeruleoalba*), rough-toothed (*Steno bredanensis*), short-beaked common (*D. delphis*, northern, central, and southern stocks combined), bottlenose (*Tursiops truncatus*), and Risso's (*Grampus griseus*) dolphins.

School (group) size

In 2006, unlike previous ETP surveys, the *David Starr Jordan* did not carry a helicopter to photograph dolphin schools. Instead, aerial photogrammetry and photography for school size calibration were carried out with fixed-wing aircraft while the ships were relatively close to the coast. From October 26-November 4 for the *Jordan* (first part of Leg 5) and from November 9-18 for the *McArthur II* (first part of Leg 4), joint ship/aricraft operations were conducted with a NOAA Twin Otter aircraft using airports along the west coast of Mexico (mainly Acapulco). On days with excellent weather (Beaufort 2 and below), the aircraft flew to the vessel area to take vertical aerial photographs of schools detected from the ship. During days of joint ship/aircraft operations, no line-transect sampling took place.

By comparing each observer's estimates of the photographed schools to the counts from the color transparencies and black-and-white negatives, individual correction or calibration coefficients were estimated (Gerrodette et al. 2002). The calibration coefficients adjusted for each observer's tendency to over- or under-estimate dolphin school size. The application of these calibration coefficients to improve observers' estimates of school sizes had a strong effect on the estimates of abundance. The 2006 aerial photography data modified these coefficients for observers who worked in previous years, and thus affected past estimates of abundance. For uncalibrated observers, or for schools which fell outside the range of school sizes for which an observer had been calibrated, we used a group average correction factor (Gerrodette and Forcada 2005).

Table 1. Area, effort, number of transects, and number of dolphin sightings in 2006 used to estimate abundance, by stratum. Strata are shown in Figure 1.

	Stratum				
	Core	Core2	Outer	N. coastal	S. coastal
Area (10^6 km^2)	5.869	0.592	14.186	0.535	0.171
Effort (km)	10,268	768	9,131	1,027	35
Number of transects	98	5	68	22	1
Number of sightings					
Offshore spotted	102	7	21	4	0
Coastal spotted	4	0	0	12	0
Eastern spinner	63	4	0	1	0
Whitebelly spinner	6	1	9	0	0
Striped	98	5	37	1	0
Rough-toothed	37	0	7	9	0
Short-beaked common	64	0	37	16	0
Bottlenose	54	4	24	42	0
Risso's	26	0	5	13	0
Unid. spotted	0	0	0	1	0
Unid. spinner	6	0	2	8	0
Unid. small dolphin	67	0	23	3	0
Unid. medium dolphin	10	0	2	4	0
Unid. large dolphin	2	0	3	0	0
Unid. dolphin	26	0	8	18	0

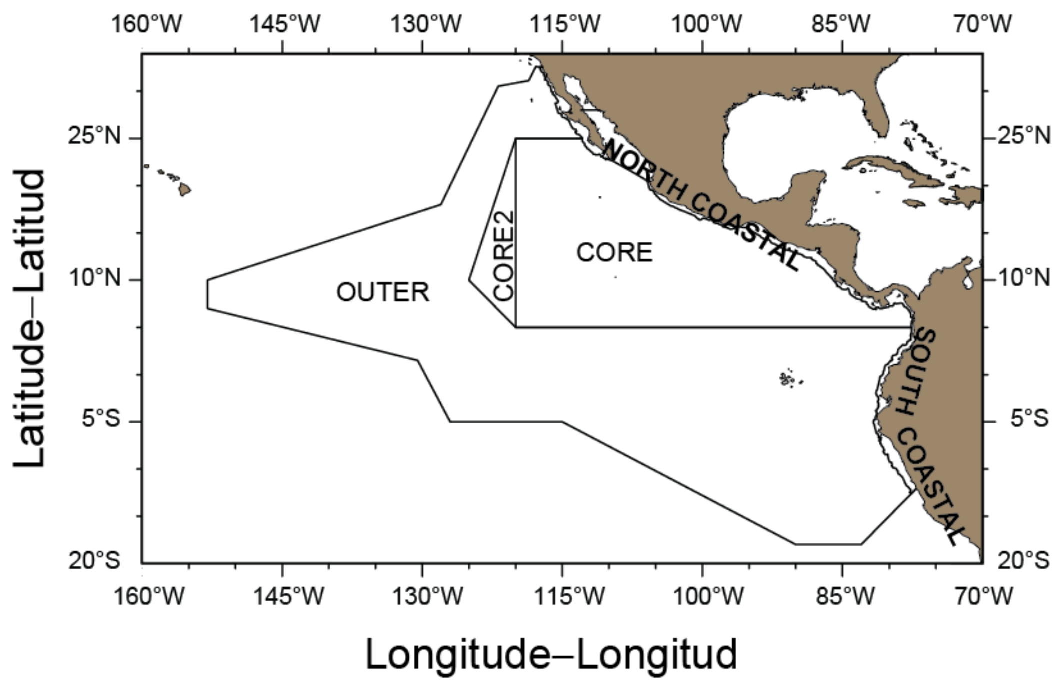

Figure 1. Strata for the STAR06 cruise.

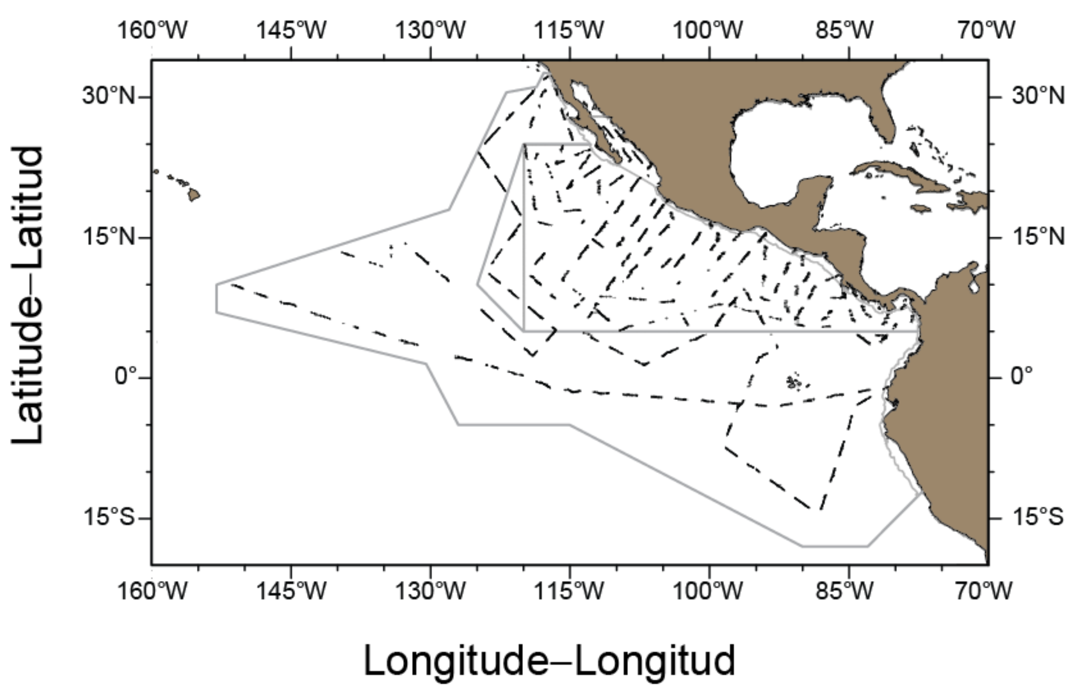

Figure 2. Line-transect effort (broken dark lines) and stratum boundaries (solid gray lines) for the STAR06 cruise.